United States
Department of
Agriculture

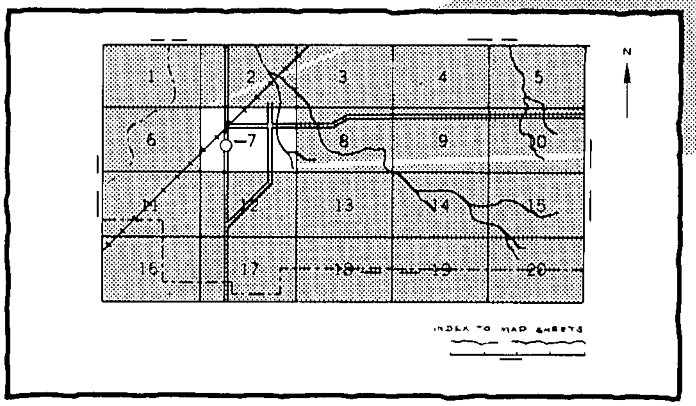
Soil
Conservation
Service

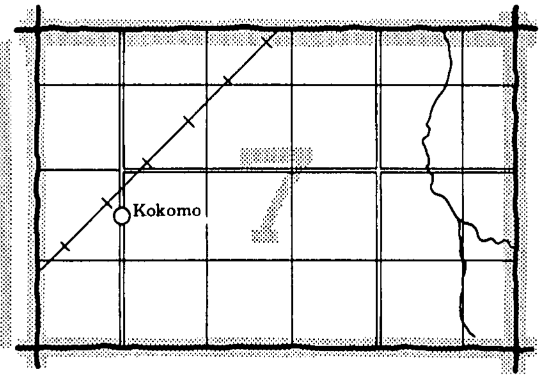
In cooperation with
University of Nebraska,
Conservation and Survey
Division

Soil Survey of Fillmore County, Nebraska

HOW TO USE

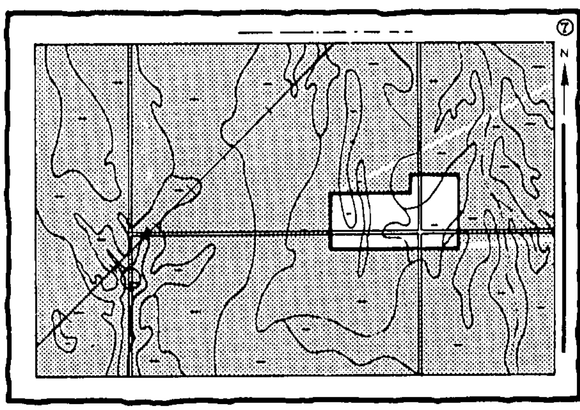
1. Locate your area of interest on the "Index to Map Sheets."

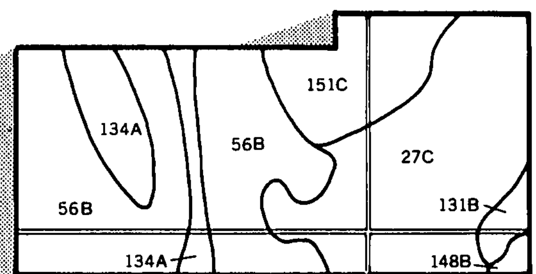




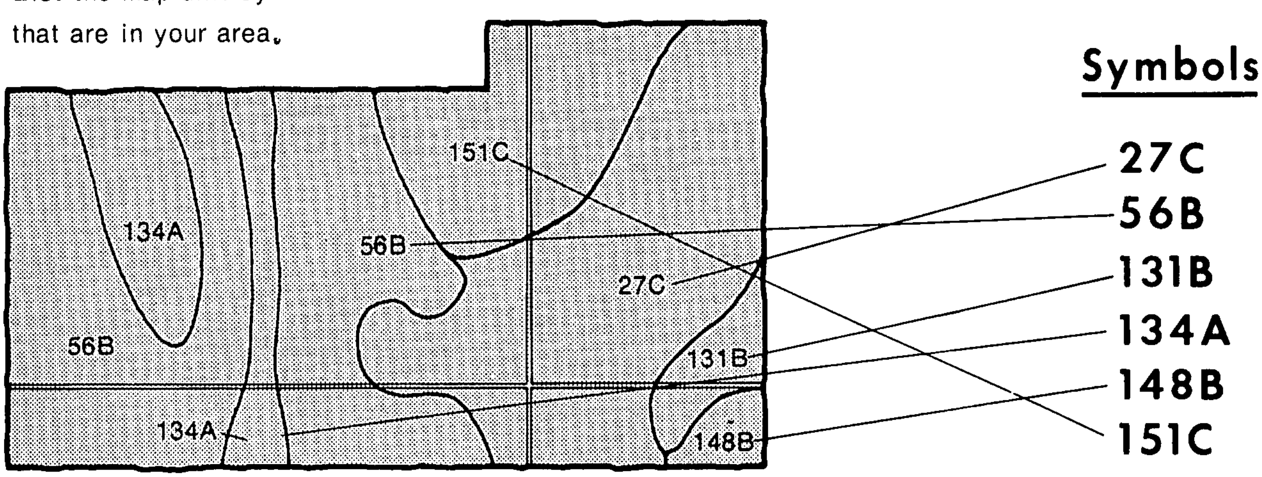
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



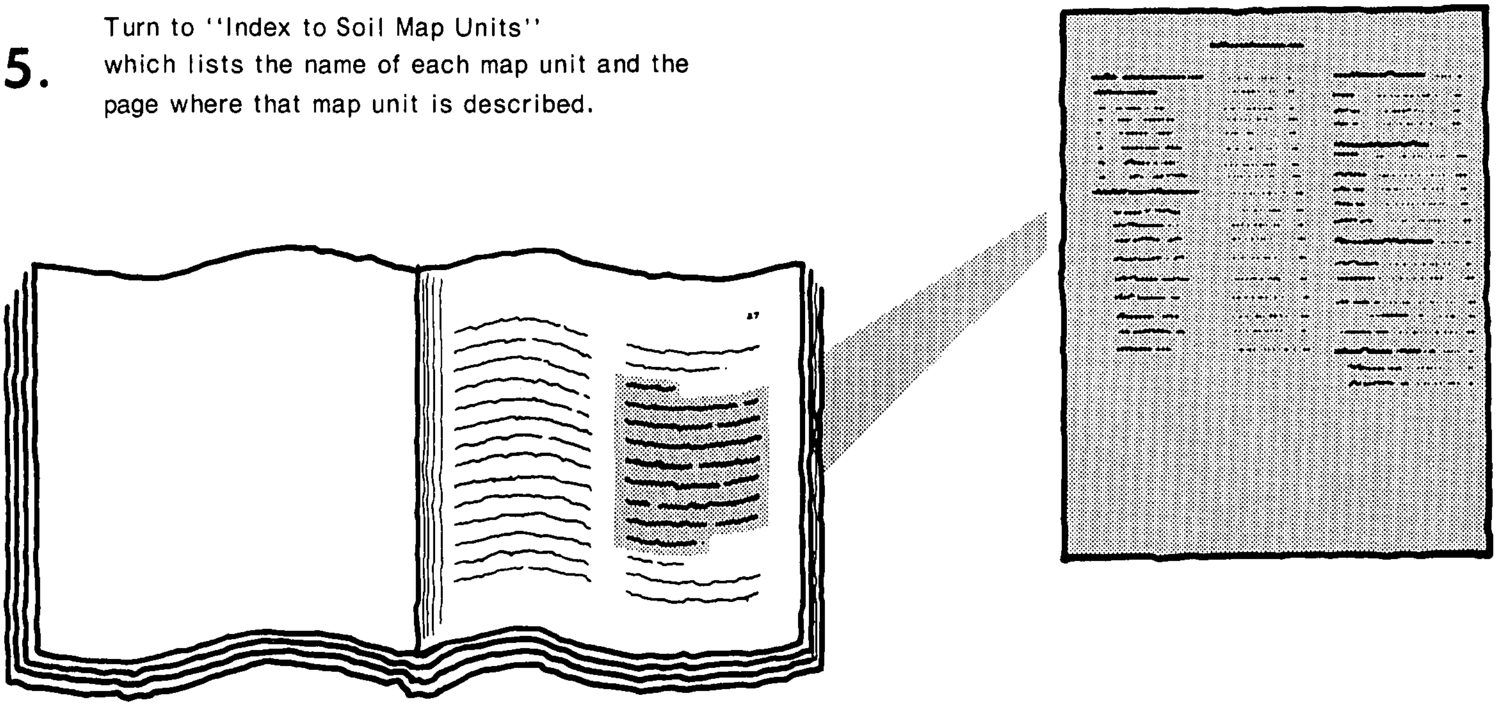


4. List the map unit symbols that are in your area.

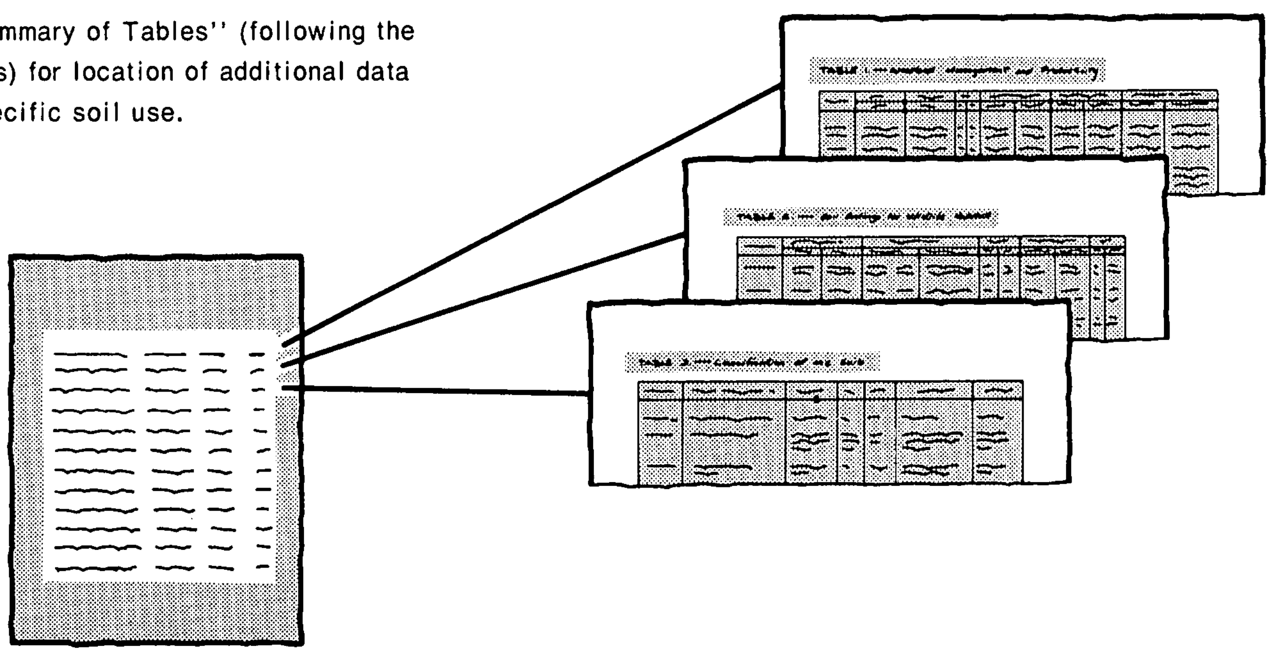


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; for specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal, state, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in 1983. Soil names and descriptions were approved in 1983. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1983. This survey was made cooperatively by the Soil Conservation Service and the University of Nebraska, Conservation and Survey Division. The survey is part of the technical assistance furnished to the Upper Big Blue and Little Blue Natural Resources Districts. The two natural resources districts and the Fillmore County Commissioners accelerated soil mapping and publication by providing financial assistance to employ a soil scientist and purchased the aerial photographs used in mapping.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: Corn and soybeans irrigated by a center-pivot sprinkler system on Hastings silt loam, 1 to 3 percent slopes.

Contents

Soil Series

Issued July 1986

Index to Map Units

Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Fillmore County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Sherman L. Lewis
State Conservationist
Soil Conservation Service

Soil Survey of
Fillmore County, Nebraska

By Roger R. Hammer and Robert S. Pollock, Soil Conservation Service,
and Arthur A. Buechle, Michael W. Reardon, and James L. Husbands,
University of Nebraska, Conservation and Survey Division

United States Department of Agriculture, Soil Conservation Service
In cooperation with
University of Nebraska, Conservation and Survey Division

FILLMORE COUNTY is in the southeastern part of Nebraska (fig. 1). It is square and has a total area of about 368,928 acres, or 576 square miles. Geneva, the county seat and largest town, is in the center of the county.

The county is in the Central Loess Plains land resource area of the Great Plains. The landscape is a nearly level and gently undulating upland plain between the Platte and Republican Rivers. Generally, the plain slopes to the southeast and is dissected by streams that flow toward the northeast, east, southeast, and south. Undulating to steep, loess-covered slopes and nearly level and very gently sloping bottom lands and terraces are along most of the streams. Ponding occurs in many shallow upland basins or depressions where a drainage system is not established.

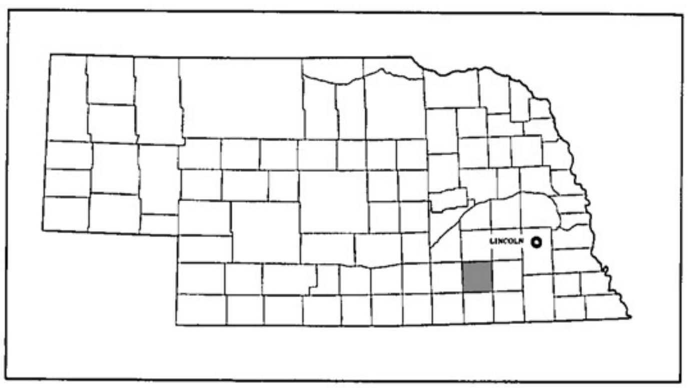


Figure 1.—Location of Fillmore County in Nebraska.

Nearly all of the land in the county is used for farms. The farms are mostly a combination of cash-grain and livestock operations. About 89 percent of the county is cropland. About 55 percent of this cropland is irrigated, mainly by water from deep wells. Rangeland makes up about 8 percent of the county, pasture about 2 percent, and windbreaks and other trees about 1 percent. Nearly all of the soils have a silty surface layer. The subsoil is silty or clayey.

According to the system of land capability classification used by the Soil Conservation Service, about 4 percent of the county is class I soils, 71 percent is class II soils, 17 percent is class III soils, 4 percent is class IV soils, less than 1 percent is class V soils, 3 percent is class VI soils, and less than 1 percent is class VIII soils.

Native vegetation covers some of Fillmore County. The areas of native grass are used mainly as rangeland. They consist mostly of soils that are strongly sloping to steeply sloping, that are frequently flooded, or that are adjacent to and in wetland basins. Native marsh plants are in the wettest basins. Many of the basins and some of the adjacent uplands are in U.S. Fish and Wildlife Service management areas. Native trees are along the main streams and along the edges of the wetland basins.

This survey updates the soil survey of Fillmore County published in 1918 (*5*). It provides additional information and larger maps, which show the soils in greater detail. The main types of additional information are in the sections on interpretations of the soils for different uses

and in the section that describes the classification of the soils.

General Nature of the County

This section provides information about some of the natural and cultural factors that affect land use in Fillmore County.

History and Development

Members of hunting parties of Plains Indians were the earliest known people in what is now Fillmore County. They used the old Pawnee Trail, which crossed the county from north to south. Remnants of the trail were plainly visible well into the 20th century (*4*).

Beginning in 1862, a series of claims were made in the county under the Free Homestead Act. Fillmore City, the first town, was established on a claim along the West Fork of the Big Blue River. The town was the site for the county's first post office. Fillmore Mill was all that remained of Fillmore City for many years. At the beginning of World War I, the mill was abandoned and torn down. It was handicapped by not being near a railroad in an era before heavy transportation by truck.

Fillmore County was established by Territorial legislation in 1869 and was organized under a proclamation of action by Governor James in the spring of 1871. The site of Geneva was surveyed and platted in June 1871, and it was incorporated as the town of Geneva in July 1879.

The westward expansion of the railroads brought about the establishment of many towns. Some of the early towns near the rail lines were Fairmont, Ohiowa, Strang, Geneva, Bixby, and Martland.

Most of Fillmore County was homesteaded by the 1880's. Most of the early settlers came from Iowa, Illinois, Missouri, and New York and other Eastern States. The town of Ohiowa, for example, was established by settlers from Ohio and Iowa. Many later settlers came from Europe. The population of Fillmore County was 14,674 in 1910, 8,137 in 1970, and 7,920 in 1983.

Farming has been and is the major business in Fillmore County. The first irrigation well was drilled in 1936, in Bryant Township. Since the dry periods of the mid-1950's, the use of deep-well irrigation has increased at a rapid rate. In 1954, there were only 100 irrigation wells. By 1957, the number was nearly 600. By 1965, it was about 730. In 1983, it was more than 1,700. Increased crop production resulting from irrigation and modern methods of farming has brought about the need for grain elevators (fig. 2). Every town has at least one grain elevator to market grain that is not used or stored on farms. From the elevator the grain is transported to larger markets by rail or truck. Livestock not sold or butchered locally is generally trucked to the larger markets. Most of the poultry and dairy products are marketed locally.

After the Dust Bowl of the 1930's, the residents of the county expressed an interest in the conservation of soil and water. The Fillmore County Soil Conservation District was established in May of 1945. It was effective for 27 years, until the advent of the Upper Big Blue and Little Blue Natural Resources Districts.

Transportation Facilities

Rural Free Delivery Route No. 1, out of Fairmont, was the second R.F.D. route to be established in Nebraska. The main modern roadways in the county are U.S. Highway 6 and State Highways 41 and 74, all of which run east-west, and U.S. Highway 81, which runs north-south. Hard-surfaced roads extend to most towns. Most of the other roads are graveled. Rural mail and school bus service are provided to all parts of the county.

Main or branch rail lines for freight reach nearly all towns in the county. Rail passenger service is available in Hastings, in Adams County, and Lincoln, in Lancaster County. Several truck lines serve the county. Bus service is available only in the towns along the major highways. Private air strips and Fairmont State Airport serve the county. The nearest municipal airports are in Hastings, Grand Island, and Lincoln. The Bruning State Airport is in Thayer County, along the county line.

Climate

Prepared by the National Climatic Center, Asheville, North Carolina.

In winter Fillmore County receives incursions of continental air that bring fairly frequent cold spells. Summers are hot but are occasionally interrupted by cool air from the north. Snowfall is fairly frequent in winter, but the snow cover is usually not continuous. Rainfall is heaviest late in spring and early in summer. The annual precipitation is normally adequate for wheat, sorghum, and range grasses.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Fairmont, Nebraska, in the period 1951 to 1980. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 27 degrees F, and the average daily minimum temperature is 15 degrees. The lowest temperature on record, which occurred at Fairmont on January 1, 1974, is -25 degrees. In summer the average temperature is 75 degrees, and the average daily maximum temperature is 88 degrees. The highest recorded temperature, which occurred on July 11, 1954, is 109 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average

Figure 2.—Gravity-irrigated soybeans are an example of a crop that can be marketed in large grain elevators.

temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 26 inches. Of this, 20 inches, or about 75 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 15 inches. The heaviest 1-day rainfall during the period of record was 6.19 inches at Fairmont on July 14, 1952. Thunderstorms occur on about 48 days each year, and most occur in summer.

The average seasonal snowfall is about 29 inches. The greatest snow depth at any one time during the period of record was 19 inches. On the average, 13 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 70 percent of the time possible in summer and 55 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 14 miles per hour, in spring.

Severe duststorms occur on occasion in spring, when strong, dry winds blow over unprotected soils. Tornadoes and severe thunderstorms, some accompanied by hail, occur occasionally. These storms are local in extent and of short duration and cause damage in scattered small areas.

Geology

Fillmore County is underlain to a depth of 60 to 450 feet by unconsolidated deposits of Quaternary age (*3*). These deposits rest on an erosion surface cut into marine-deposited bedrock of Cretaceous age. This erosion surface consists of valleys and high hills. The configuration of this surface is the primary reason for the wide differences in the thickness of the Quaternary deposits (*9*).

The Quaternary deposits consist of sediments deposited by wind, water, and glaciers. Loess, a wind-deposited silty material, is on the surface of most of Fillmore County. Nearly all of the uplands, including the side slopes of drainageways, are covered by loess. Depressions and small drainageways are floored by water-deposited material eroded from adjacent side slopes.

Clayey to gravelly, water-deposited sediments are exposed in some areas where streams have cut valleys into the sediments. Most of these exposed sediments are near School Creek, the West Fork of the Big Blue River, and the eastern part of Turkey Creek. Stream terrace deposits in the valleys were derived from loess and from the underlying sediments exposed and eroded as the valleys were cut. The alluvium of recent age along the streams is derived from loess and some sand washed from valley side slopes.

The glacial deposits in Fillmore County are not exposed. Glacial till is below the surface in or near Geneva, Fairmont, Exeter, and Milligan.

Ground Water

In Fillmore County ground water is the main source of water for irrigation, for livestock, and for municipal, domestic, and industrial uses (*9*). Nearly all of the ground water used is pumped from saturated, water-deposited sediments of Quaternary age. This saturated zone ranges in thickness from as little as 20 feet over the highest bedrock hill to as much as 350 feet in the deepest bedrock valley. The depth to the water table is greatest in the uplands and least in the stream valleys. For example, the depth is about 100 feet in the areas north of Fairmont and near the Clay County line, northwest of Shickley. The depth is less than 60 feet in the Milligan-Ohiowa area.

In an area near Geneva and in other areas, a thick deposit of sand and gravel transmits water effectively. Some wells in this material yield more than 1,000 gallons per minute. In some areas, however, the material does not transmit water effectively, resulting in low yielding wells. One such area is between the Clay County line and the northwestern and west-central parts of the county, and one is between the area near Milligan and Ohiowa and the Saline County line. Yields from wells in these areas are low but are generally adequate for domestic use and for use by livestock. Of the low-yielding areas, the one in the northwestern part of the county produces the better yields. Irrigation wells in that area produce about 500 to 800 gallons per minute.

The amount of water used for irrigation in Fillmore County exceeds the amount that can be recharged. Ground water is recharged by several processes. Precipitation that infiltrates the soil is transferred to the zone of saturation. The return of irrigation water replaces only a small percentage of the water that is withdrawn. Flowing streams and bodies of water seep to the zone of saturation. Some water percolates into the county from the west, but it moves very slowly.

In an area in the northeastern part of the county, a water table is perched on a layer of nearly impervious clay that inhibits the transfer of moisture from the soil zone to the main body of ground water. A few low-capacity wells tap into this perched zone. The perched water table is in reach of deep-rooted plants. The fluctuation in the depth of the perched water table is greater than that of the underlying ground water and is independent of the ground water. Irrigation recharge can raise this perched water table.

Most of the ground water in Fillmore County is hard. This hardness does not affect irrigation and can be corrected for domestic and industrial uses. Water in the Quaternary deposits, consisting of mostly sand and gravel, contains a large amount of calcium carbonate. In areas where these deposits mainly are fine grained sediments, such as the Milligan-Ohiowa area and the west-central part of the county that is the Clay County line, the water is much harder and is difficult to obtain. An alternative source of water in the Milligan-Ohiowa area is deep wells drilled into Dakota Sandstone. This water is mineralized but soft. It is satisfactory for use by livestock but commonly requires treatment before it is suitable for human consumption. The creviced and weathered parts of the Niobrara Formation are potential sources of water in the west-central part of the county. Only a few wells have tapped into this source. The only other part of the county underlain by the Niobrara Formation is the northwestern part. The other kinds of bedrock in the county do not yield water to wells.

The West Fork of the Big Blue River, School Creek, and the eastern part of Turkey Creek are perennial and provide water for irrigation, livestock, and recreation. Many tailwater recovery pits, dugouts, and dams provide water for irrigation, livestock, wildlife, and recreation. A few intermittent lakes and many wetland depressions provide intermittent water for wildlife.

Physiography, Relief, and Drainage

Fillmore County is the Central Loess Plains land resource area, which is part of the Great Plains physiographic province. The general physiography of the county consists of a nearly level and gently undulating, southeastward-sloping plain dissected by streams and

modified by many depressions of different sizes. The county is entirely in the drainage basins of the Big Blue River and the Little Blue River. School Creek, the West Fork of the Big Blue River, and the eastern part of Turkey Creek are the only perennial streams in the county. Most of the bottom lands and stream terraces are very narrow.

The West Fork of the Big Blue River and its tributaries dissect the northern part of the county. The river valley ranges from about one-half to three-quarters of a mile in width, and its floor is about 100 feet below the uplands. The valley consists of nearly level and very gently sloping stream terraces 5 to 15 feet above the river channel and occasionally flooded and frequently flooded bottom lands. The major tributaries of the West Fork of the Big Blue River are School Creek and Elk Run, which join in Fillmore County, and Indian Creek and the North and South Forks of Johnson Creek, which join outside the county.

Turkey Creek flows from Clay County through the central part of Fillmore County and into Saline County. It is the longest stream in Fillmore County. Its valley is less than one-half mile wide and is about 50 feet below the uplands. The major tributaries of Turkey Creek are the North and South Forks.

The major drainageways in the southwestern part of the county are Little Sandy Creek, which dissects the extreme southwest corner of the county, and Dry Sandy Creek, which flows through Shickley and southeastward into Thayer County. The drainageways in the southeastern part are another Little Sandy Creek, which flows on the east side of Ohiowa and southward into Thayer, and Walnut Creek, which flows south of Milligan and into Saline County.

In some areas in the county, nearly level and very gently sloping uplands are dissected by more sloping small drainageways, some of which flow through broad basins or into depressions. The broad basins range from 300 to 3,000 acres in size. Water is ponded in the undrained areas from brief to very long periods. Many of these broad basins and depressions are oriented southwest to northeast. A more undulating topography is common where the depressions are most numerous.

Nearly level soils make up about 57 percent of Fillmore County, very gently sloping soils about 26 percent, gently sloping soils about 12 percent, strongly sloping soils about 3 percent, moderately steep soils about 1 percent, and steep soils about 1 percent. Moderately well drained soils make up about 55 percent of the county, well drained soils about 23 percent, somewhat poorly drained soils about 17 percent, poorly drained soils about 4 percent, and very poorly drained soils about 1 percent.

The range in elevation in the county is about 1,500 to 1,750 feet above sea level. The highest elevation is near the Clay County line, just southeast of Sutton, in Clay County. The lowest is in an area where Turkey Creek enters Saline County. The elevation of some of the major towns is as follows: Grafton, 1,690 feet; Geneva, 1,651 feet at the courthouse; Shickley, 1,650 feet; Exeter, 1,610 feet; and Ohiowa, 1,590 feet.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, acidity, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of

horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Some soil boundaries and soil names may not fully match those in surveys of adjoining areas that were published at an earlier date. Differences result from changes and refinements in series concepts, different

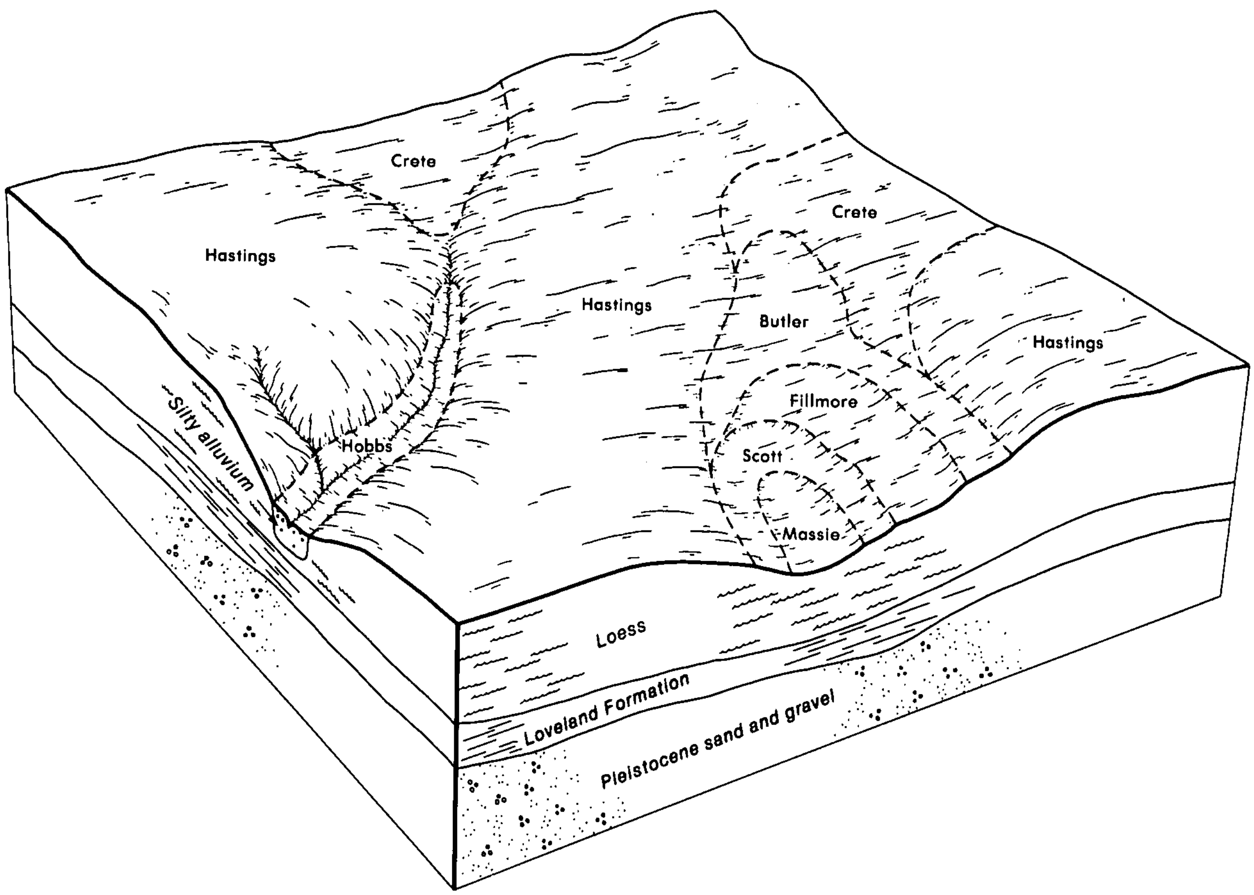


Figure 3.—Typical pattern of soils, topography, and parent material in the Hastings-Crete association.

slope groupings, and application of the latest soil classification system.

Descriptions of Soil Associations

1. Hastings-Crete Association

Deep, nearly level to gently sloping, well drained and moderately well drained, silty soils on uplands

This association consists mainly of soils on broad, plane and undulating divides that have many slightly concave areas, a few broad basins, and some narrow drainageways. The soils on the divides generally are nearly level and very gently sloping, but some are gently sloping. The soils on the sides of drainageways generally are gently sloping, but some are very gently sloping. Those in the concave areas and broad basins are nearly level.

This association occupies about 39,992 acres, or about 11 percent of the county. It is about 72 percent Hastings soils, 14 percent Crete soils, and 14 percent soils of minor extent (fig. 3).

The well drained Hastings soils are mostly on broad, nearly level or very gently sloping divides. In some areas they are on the gently sloping ridges of divides and the very gently sloping or gently sloping sides of narrow drainageways. Typically, the surface layer and subsurface layer are grayish brown and dark grayish brown, friable and very friable silt loam. In eroded areas the surface layer is grayish brown silty clay loam. The subsoil is silty clay loam. It is dark brown and brown in the upper part and pale brown in the lower part. The underlying material is very pale brown silt loam.

The moderately well drained Crete soils are mostly on nearly level divides. In a few areas they are on very gently sloping divides and sides of drainageways. Typically, the surface layer is grayish brown, very friable silt loam. The subsurface layer is grayish brown, very friable silty clay loam. The subsoil is dark brown and brown silty clay in the upper part and light yellowish brown, calcareous silty clay loam in the lower part. The underlying material is light yellowish brown, calcareous silty clay loam.

The minor soils in this association are the Butler, Fillmore, Hobbs, Massie, and Scott soils. The somewhat poorly drained Butler soils are in slightly concave areas and broad basins. Fillmore, Massie, and Scott soils are in depressions that are subject to ponding. Hobbs soils are in narrow drainageways that are subject to flooding.

Farms in areas of this association are diversified. They consist mainly of cash-grain and livestock enterprises. The soils on the divides are used mainly for irrigated crops, such as corn, and those in the drainageways are used mainly for dryland crops, such as grain sorghum and wheat. Along the Clay-Fillmore County line, an area extends on both sides of Nebraska Highway 41 into Clay County. The potential of this area for irrigation is poor because most well yields are poor. Another area extends north and then northeast of Grafton into Clay and York Counties. Well yields in this area are only fair. Dryland crops are dominant in both of these areas. Most areas of range and pasture are small areas of the minor Fillmore and Scott soils and the soils along narrow drainageways. The Fillmore, Scott, and Massie soils provide habitat for migratory waterfowl. Some livestock is fattened in feedlots or raised for breeding stock on farms.

Soil blowing is a slight hazard on the nearly level cultivated soils, and water erosion is the main hazard on the more sloping cultivated soils. Conserving soil moisture is a concern in managing cultivated soils. On the claypan soils in the association, available water is released slowly to plants during periods of drought and wetness is a limitation during wet periods. Fillmore, Massie, and Scott soils are periodically ponded from about March to August. In wet years some areas of Massie and Scott soils are ponded throughout the year. Management of irrigation water is important on irrigated land. Proper grazing use is a concern in managing range.

Farms in areas of this association average about 480 acres in size. Paved highways cross parts of this association. Grain and other farm products are marketed mainly within the county or in nearby markets, such as Stockham, in Hamilton County; Henderson and McCool Junction, in York County; Cordova, in Seward County; and Friend, in Saline County. Livestock is marketed in Geneva and in nearby towns, such as Sutton, in Clay County, and York, in York County.

2. Hastings-Uly-Geary Association

Deep, gently sloping to steep, well drained and somewhat excessively drained, silty soils on uplands

This association consists of soils on the sides of drainageways and on upland breaks to stream terraces and bottom lands.

This association occupies about 13,921 acres, or about 4 percent of the county. It is about 53 percent Hastings soils, 18 percent Uly soils, 10 percent Geary soils, and 19 percent soils of minor extent (fig. 4).

The well drained Hastings soils are on the gently sloping and strongly sloping sides of drainageways. The eroded Hastings soils typically have a surface layer of grayish brown, firm silty clay loam. The uneroded Hastings soils have a surface layer of dark gray, very friable silt loam. The subsoil is silty clay loam. It is brown in the upper part and pale brown in the lower part. The underlying material is light olive brown, light yellowish brown, and pale yellow silt loam. It is calcareous in the lower part.

The somewhat excessively drained Uly soils are on the moderately steep and steep sides of drainageways and upland breaks. Typically, the surface layer is grayish brown, very friable silt loam. In eroded Uly soils, however, it is brown, very friable silt loam. The subsoil is brown silt loam in the upper part, pale brown silty clay

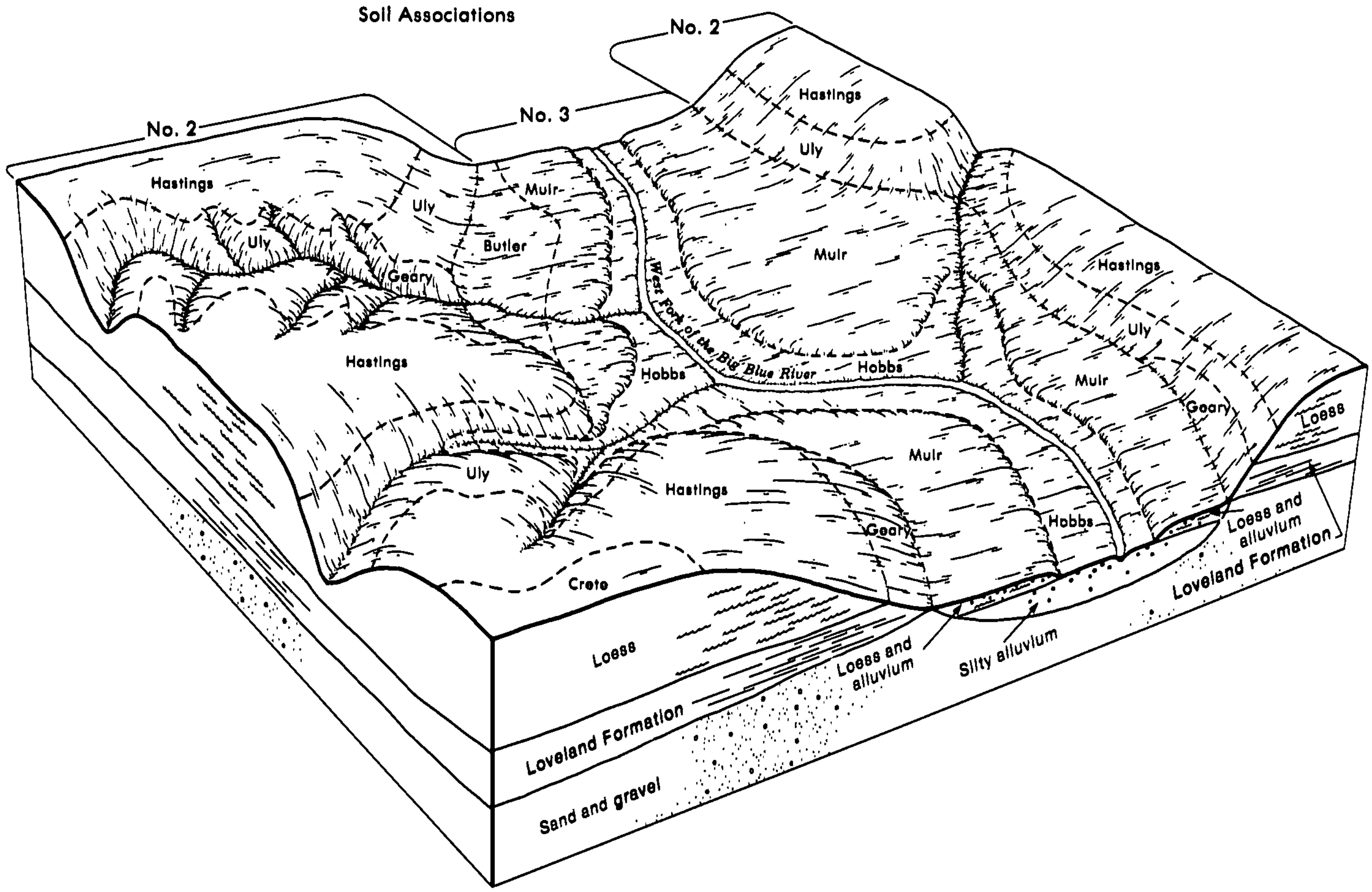


Figure 4.—Typical pattern of soils, topography, and parent material in the Hastings-Uly-Geary and Muir-Hobbs-Butler associations.

loam in the next part, and very pale brown silt loam in the lower part. The underlying material is pale yellow, calcareous silt loam.

The well drained and somewhat excessively drained Geary soils are on the gently sloping to steep sides of drainageways and upland breaks. Typically, the surface layer is grayish brown, very friable silt loam. In eroded Geary soils, however, it is brown, firm silty clay loam. The subsoil is silty clay loam. It is brown in the upper part and light brown in the lower part. The underlying material is pink, calcareous silty clay loam.

The minor soils in this association are the Crete, Hobbs, and Muir soils. Crete soils are moderately well drained and are on the gently sloping sides of drainageways. Hobbs soils are on bottom lands that are subject to flooding. The dark Muir soils are on terraces adjacent to bottom lands.

Farms in areas of this association are diversified. They consist mainly of a combination of cash-grain and livestock enterprises. The soils are used mainly for dryland crops, for pasture, and for range. Grain sorghum, wheat, and alfalfa are the principal crops. Some of the strongly sloping soils and nearly all of the steep soils are used for range and pasture. Some livestock is fattened in feedlots or raised for breeding stock.

Water erosion is the main hazard on the sloping cultivated soils in this association. Low organic matter content is a management concern on the eroded soils. Irrigation is limited because of the strongly sloping and steep soils. Flooding is a hazard on the bottom-land soils. Overgrazing is a concern in managing range.

Farms in areas of this association average about 320 acres in size. Paved highways cross some parts of this association. A few sources of sand and gravel are in areas of the Geary soils. A small sand pit is along School Creek, and a large one is near the mouth of Elk Run. Grain and other farm products are sold mainly in the county and in nearby markets, such as Lushton and McCool Junction, in York County; Ong, in Clay County; and Davenport and Carleton, in Thayer County.

Livestock is marketed in Geneva and in York, in York County, and Hebron, in Thayer County.

3. Muir-Hobbs-Butler Association

Deep, nearly level to gently sloping, well drained and somewhat poorly drained, silty soils on stream terraces, foot slopes, and bottom lands

This association consists of soils on alternating foot slopes, terraces, and bottom lands along perennial and intermittent streams. It is in stream valleys of the West Fork of the Big Blue River and Turkey Creek. The soils on the terraces generally are nearly level, but some are very gently sloping. Those on the bottom lands are nearly level and are broken by meandering channels and streambanks.

This association occupies about 11,704 acres, or about 3 percent of the county. It is about 62 percent Muir soils, 29 percent Hobbs soils, 8 percent Butler soils, and 1 percent soils of minor extent (fig. 4).

The well drained Muir soils are on nearly level stream terraces, gently sloping colluvial foot slopes between the uplands and the terraces, and the sides of a few very gently sloping drainageways that cross the terraces. Typically, the surface layer and subsurface layer are grayish brown and dark grayish brown, very friable silt loam. The subsoil is dark grayish brown silty clay loam in the upper part and grayish brown silt loam in the lower part. The underlying material is stratified grayish brown and light gray silt loam.

The well drained Hobbs soils are on nearly level bottom lands. Typically, the surface layer is stratified dark grayish brown and light brownish gray, very friable silt loam. The underlying material is stratified dark grayish brown and light brownish gray silty clay loam in the upper part, dark grayish brown and grayish brown silt loam in the next part, and stratified brown and pale brown loam in the lower part.

The somewhat poorly drained Butler soils are on nearly level stream terraces. Typically, the surface layer is dark gray, very friable silt loam. The subsurface layer is very dark gray and gray, very friable silt loam. The subsoil is very dark gray silty clay in the upper part, very dark grayish brown silty clay in the next part, and dark grayish brown, calcareous silty clay loam in the lower, part. The underlying material is brown and pale brown, calcareous silty clay loam.

The minor soils in this association are the Kezan and Uly soils. The somewhat excessively drained Uly soils are on the sides of a few drainageways that cross the terraces. The poorly drained Kezan soils are on bottom lands and are frequently flooded.

Farms in areas of this association are diversified. They consist mainly of a combination of cash-grain and livestock enterprises. The soils on the terraces are used primarily for dryland and irrigated crops. Corn is the major irrigated crop, and grain sorghum, alfalfa, and wheat are the main dryland crops. Most of the soils on the bottom lands are used for range and pasture or support trees and provide habitat for wildlife. Some livestock is fattened in feedlots or raised for breeding stock.

Soil blowing is a slight hazard on the nearly level soils on terraces. In the Butler soils, available water is released slowly to plants during periods of drought and wetness is a limitation during wet periods. Water erosion is the main hazard on the sloping cultivated soils. Frequent flooding is the main hazard on the bottom-land soils. Management of irrigation water is important on irrigated land. Measures that maintain bridges and culverts are needed on bottom lands.

Farms in areas of this association average about 240 acres in size. Paved highways do not cross most areas but are nearby. A few sand pits are on the bottom lands. Grain and other farm products are marketed mainly in the county and in nearby markets, such as Lushton and McCool Junction, in York County, and Friend, in Saline County. Livestock is marketed in Geneva and in nearby towns, such as Sutton, in Clay County; York, in York County; and Crete, in Saline County.

4. Crete-Hastings-Massie Association

Deep, nearly level to gently sloping, moderately well drained, well drained, and very poorly drained, silty soils on uplands and in upland depressions

This association consists mainly of soils on undulating divides and in many depressions. The soils on the divides are mostly very gently sloping. The soils in the depressions are nearly level.

This association occupies about 21,396 acres, or about 6 percent of the county. It is about 45 percent Crete soils, 15 percent Hastings soils, 9 percent Massie soils, and 31 percent soils of minor extent.

The moderately well drained Crete soils mainly are on very gently sloping divides. In some areas they are on gently sloping divides, and in a few areas they are on nearly level divides, in nearly level basins, and on the sloping sides of drainageways that drain into depressions. Typically, the surface layer is gray, very friable silt loam. In eroded areas, however, it is grayish brown, firm silty clay loam. The subsoil is dark gray silty clay loam in the upper part, brown and grayish brown silty clay in the next part, and light yellowish brown, calcareous silty clay loam in the lower part. The underlying material is very pale brown, calcareous silt loam.

The well drained Hastings soils mainly are on gently sloping divides. In some areas they are on very gently sloping divides, and in a few areas they are on the sides of drainageways that drain into depressions. Typically, the surface layer is grayish brown, very friable silt loam. In eroded areas, however, it is grayish brown, firm silty clay loam. The subsoil is silty clay loam. It is dark grayish brown in the upper part, brown in the next part, and pale

brown in the lower part. The underlying material is pale brown silt loam. It is calcareous in the lower part.

The very poorly drained Massie soils are in the lowest, wettest parts of nearly level depressions. Typically, they have a thin layer of partially decayed leaves and stems over a dark gray surface layer of silty clay loam. The subsurface layer is light gray silt loam. The subsoil is gray silty clay loam in the upper part, gray silty clay in the next part, and light brownish gray silty clay and pale olive silty clay loam in the lower part.

The minor soils in this association are the Butler, Fillmore, and Scott soils. Butler soils are somewhat poorly drained and are on the slightly concave parts of divides. Fillmore soils are poorly drained and are in depressions that are subject to ponding. Scott soils are in depressions and are poorly drained and very poorly drained. They are slightly lower on the landscape than the Fillmore soils and slightly higher than the Massie soils. In places they are in a circle or semicircle around the Massie soils.

Farms in areas of this association are diversified. They consist mainly of a combination of cash-grain and livestock enterprises. The soils on the undulating divides are used for irrigated crops, such as corn, and dryland crops, such as grain sorghum and wheat. The center-pivot sprinkler system is the main type of irrigation. It commonly is limited because of the poorly drained and very poorly drained soils in depressions. Most areas of range and pasture are small and consist of Fillmore and Scott soils and the adjacent sloping soils. Most of the larger areas of Fillmore and Scott soils are part of a national wildlife management area. These areas and most of the acreage of the Massie soils are used primarily as habitat for wetland wildlife.

Water erosion is the main hazard on the cultivated Crete and Hastings soils. Fillmore, Scott, and Massie soils are ponded for long or very long periods from March to about August. During some wet years the Massie soils and some areas of the Scott soils are ponded throughout the year. Proper grazing use is a management concern on range in areas of wildlife habitat.

Farms in areas of this association average about 400 acres in size. Paved highways are near most parts of this association. Grain and other farm products are sold mainly in the county and in nearby markets, such as Ong, in Clay County. Livestock is sold mainly in Geneva and in nearby towns, such as Sutton, in Clay County.

5. Crete-Butler Association

Deep, nearly level to gently sloping, moderately well drained and somewhat poorly drained, silty soils on uplands

This association is mostly on broad, plane and undulating divides characterized by many slightly concave areas. It also is in a few broad basins and in some narrow drainageways. The soils on the divides generally are nearly level and very gently sloping, but in a few areas they are gently sloping. Those on the sides of the drainageways are very gently sloping and gently sloping. Those in the concave areas and broad basins are nearly level.

This association occupies about 243,241 acres, or about 66 percent of the county. It is about 71 percent Crete soils, 17 percent Butler soils, and 12 percent soils of minor extent (fig. 5).

The moderately well drained Crete soils are mostly on the broad, nearly level and very gently sloping divides. In a few areas they are on the gently sloping divides, and in some areas they are on the gently sloping and very gently sloping sides of narrow drainageways. Typically, the surface layer is grayish brown, very friable silty clay loam. In an area east of Strang, however, it is dominantly firm silty clay loam and there is no subsurface layer. The subsoil is dark brown silty clay in the upper part, brown silty clay in the next part, and light yellowish brown, calcareous silty clay loam in the lower part. The underlying material is light yellowish brown, calcareous silty clay loam.

The somewhat poorly drained Butler soils are in the nearly level, slightly concave areas and broad basins on the divides. In many areas they are at the head of drainageways. Most of the broad basins are dissected by drainageways. Typically, the surface layer is grayish brown and dark grayish brown, very friable silt loam, and the subsurface layer is gray, very friable silt loam. In an area east of Strang, however, the surface layer is dominantly firm silty clay loam and there is no subsurface layer. The subsoil is dark gray silty clay in the upper part, gray silty clay in the next part, and grayish brown, calcareous silty clay loam in the lower part. The underlying material is pale olive and pale yellow silt loam. It is calcareous in the upper part.

The minor soils in this association are the Fillmore, Hastings, Hobbs, Massie, and Scott series. Fillmore, Massie, and Scott soils are in depressions that are subject to ponding. Hastings soils are well drained and are on the higher parts of the association. Hobbs soils are in narrow drainageways that are subject to flooding.

Farms in areas of this association are diversified. They are mainly the cash-grain type, but some are a combination of cash-grain and livestock. The soils on the divides are used mainly for irrigated crops, such as corn, and those in the drainageways are used mainly for dryland crops, such as grain sorghum and wheat. The potential for irrigation is poor in parts of this association because of low ground-water yields. Examples are an area in the west-central part of the county, extending from the Clay County line, and a larger area in the southeastern part of the county, extending from the Saline County line to the vicinity of Milligan and Ohiowa. Most areas of range and pasture are small and consist of Fillmore and Scott soils and soils along narrow drainageways. Wetland areas consist of Fillmore, Scott,

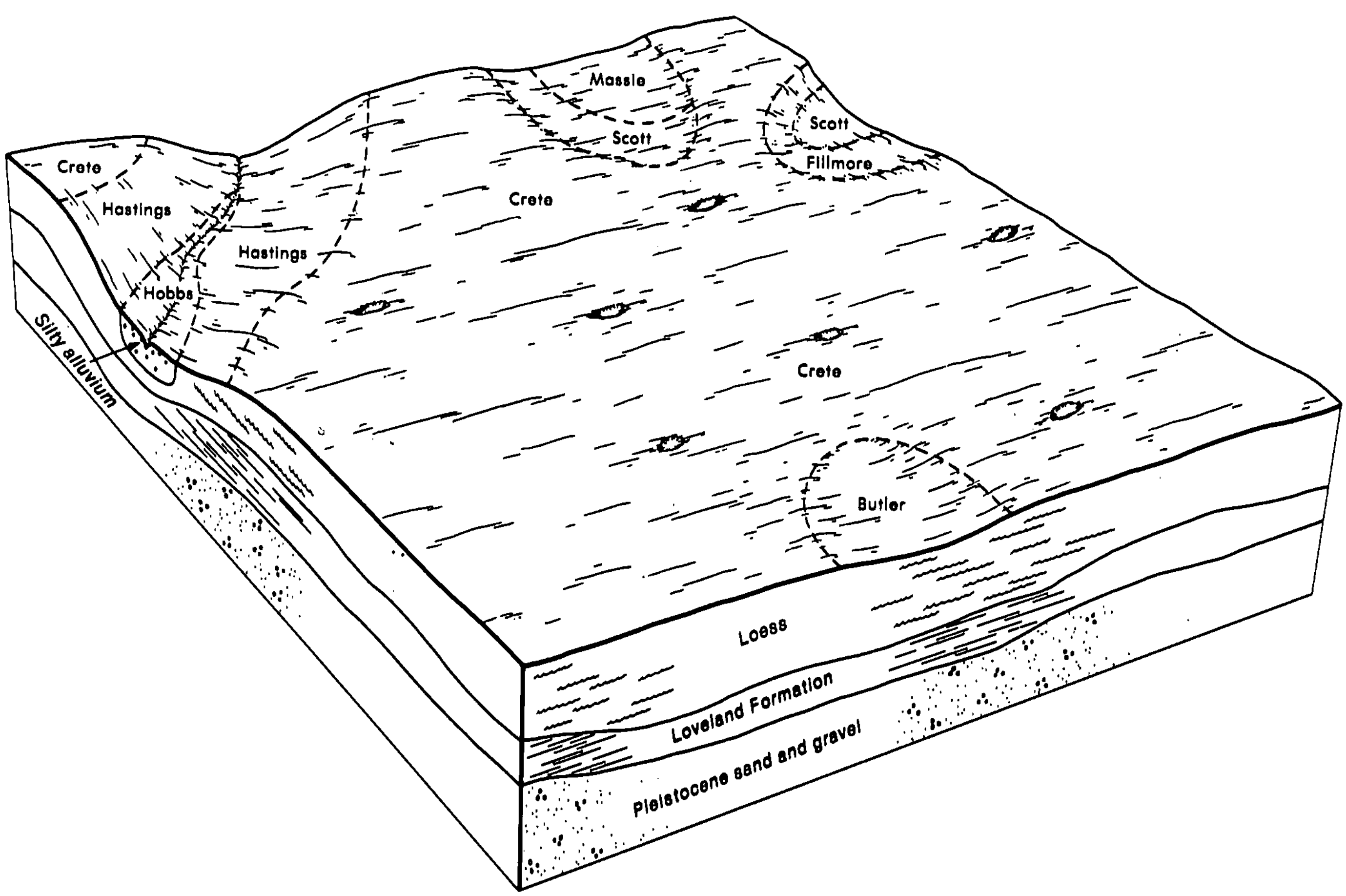


Figure 5.—Typical pattern of soils, topography, and parent material in the Crete-Butler association.

and Massie soils. Livestock is fattened in feedlots or raised for breeding stock on some farms.

In the soils that have a claypan, available water is released slowly to plants during periods of drought and wetness is a limitation during some wet periods. The Fillmore, Massie, and Scott soils are ponded for long or very long periods from about March to August. During some wet years, some areas of the Massie and Scott soils are ponded throughout the year. Soil blowing is a hazard on the nearly level cultivated soils, and water erosion is the main hazard on the more sloping cultivated soils. Conserving soil moisture also is a management concern. Measures that control and conserve water are needed on irrigated land. Proper grazing use is a management concern on range.

Farms in areas of this association average about 560 acres in size. Paved highways cross most of this association. Grain and other farm products are sold mainly in the county and in nearby markets. Livestock is sold in Geneva and in nearby markets.

6. Olbut-Butler Association

Deep, nearly level, somewhat poorly drained, silty soils that are dominantly saline; on uplands

This association consists mainly of soils in shallow depressions and plane and slightly concave areas on divides.

This association occupies about 9,484 acres, or about 2 percent of the county. It is about 48 percent Olbut soils, 33 percent Butler soils, and 19 percent soils of minor extent.

The somewhat poorly drained Olbut soils are mostly in plane or slightly concave areas and in shallow depressions. Typically, the surface layer is grayish brown, very friable silt loam. The subsoil is dark gray and gray silty clay in the upper part and olive gray silty clay loam in the lower part. The middle and lower parts of the subsoil are calcareous and saline. The underlying material is pale yellow, calcareous and saline silty clay loam.

The somewhat poorly drained Butler soils are in plane and slightly concave areas on uplands. Typically, the surface layer is gray and very friable silt loam. The subsoil is very dark gray silty clay in the upper part, dark grayish brown silty clay in the next part, and grayish brown, calcareous silty clay loam in the lower part. The underlying material is light brownish gray and light gray, calcareous silty clay loam and silt loam.

The minor soils in this association are the Crete, Fillmore, Kezan, and Scott soils. The moderately well drained Crete soils are on the higher convex parts of the association. The poorly drained Fillmore and poorly drained and very poorly drained Scott soils are in depressions that are subject to ponding. The poorly drained Kezan soils are on the narrow bottoms of drainageways that are subject to flooding.

Farms in areas of this association are diversified. They mainly are a combination of cash-grain and livestock enterprises. Corn, grain sorghum, small grain, and alfalfa are the main crops. Some of the soils are used for dryland crops, and some are irrigated. In the southeastern part of the county, near Ohiowa, lack of ground water prevents irrigation. The main areas of range and pasture consist of Kezan, Olbut, Fillmore, and Scott soils. Some livestock is raised for breeding stock or fattened in feedlots on farms.

In most of the soils, available water is released slowly to plants during periods of drought and wetness is a limitation during wet periods. A high salt content and low fertility level in the Olbut soils are additional limitations. Soil blowing is a hazard in some cultivated areas. The Fillmore and Scott soils are ponded for long or very long periods, mainly from about March through July. Management of water on irrigated land is needed to help control salt buildup in the root zone. In the areas of this association in the northeastern part of the county, a perched water table provides water to deep-rooted plants, such as alfalfa and trees.

Farms in areas of this association average about 320 acres in size. Paved highways cross the association or are nearby. Grain and other farm products are sold mainly in the county or in nearby markets, such as Friend and Tobias, in Saline County. Livestock is sold in Geneva and in adjacent counties.

7. Hastings-Crete-Geary Association

Deep, gently sloping to steep, well drained, moderately well drained, and somewhat excessively drained, silty soils on uplands

This association consists of soils in drainageways, on narrow divides, and on upland breaks to stream terraces or bottom lands. It is along Turkey Creek, Dry Sandy Creek, Little Sandy Creek, and Walnut Creek. The soils on the sides of the drainageways and upland breaks are gently sloping to steep, and those on the narrow divides are gently sloping and strongly sloping.

This association occupies about 29,188 acres, or about 8 percent of the county. It is about 43 percent Hastings soils, 29 percent Crete soils, 9 percent Geary soils, and 19 percent soils of minor extent (fig. 6).

The well drained, gently sloping and strongly sloping Hastings soils are mostly on the upper side slopes of drainageways and on upland breaks to stream terraces and bottom lands. In some areas they are on narrow, convex divides above the Geary soils and between steep drainageways. The eroded Hastings soils typically have a surface layer of grayish brown, firm silty clay loam. The uneroded Hastings soils have a surface layer of dark gray, very friable silt loam. The subsoil is silty clay loam. It is brown in the upper part and light yellowish brown in the lower part. The underlying material is pale brown and very pale brown silt loam. It is calcareous in the lower part.

The moderately well drained, gently sloping Crete soils are on narrow divides and the sides of drainageways. Typically, the surface layer is grayish brown, firm silty clay loam. The subsoil is dark brown and brown silty clay in the upper part and light yellowish brown, calcareous silty clay loam in the lower part. The underlying material is very pale yellow, calcareous silt loam.

Geary soils are gently sloping to steep. They are generally on the lower side slopes of drainageways and on upland breaks to stream terraces and bottom lands. In some areas they are on narrow, convex divides below the Hastings soils and between steep drainageways. The gently sloping and strongly sloping Geary soils are well drained, and the moderately steep and steep Geary soils are somewhat excessively drained. Typically, the surface layer is grayish brown, very friable silt loam. In eroded areas, however, it is brown, firm silty clay loam. The subsoil is silty clay loam. It is brown in the upper part and light brown in the lower part. The underlying material is pink, calcareous silty clay loam.

The minor soils in this association are the Hobbs, Muir, Kezan, and Uly series. Hobbs and Kezan soils are on bottom lands that are subject to flooding. Muir soils are on stream terraces and colluvial foot slopes. Uly soils have less clay in the subsoil than the Geary soils. They are on the steep sides of drainageways at elevations higher than those of the Geary soils.

Farms in areas of this association are diversified. They consist mainly of a combination of cash-grain and livestock enterprises. The soils are used mainly for dryland crops, for pasture, and for range. Grain sorghum, wheat, and alfalfa are the principal crops. Most of the narrow, convex divides between steep drainageways and nearly all of the steep soils and the bottom-land soils are used for range or pasture. Some livestock is fattened in feedlots or raised for breeding stock.

Water erosion is the main hazard on the cultivated soils. In areas of the minor Hobbs and Kezan soils, flooding is a hazard and meandering channels are problems. A low organic matter content is a

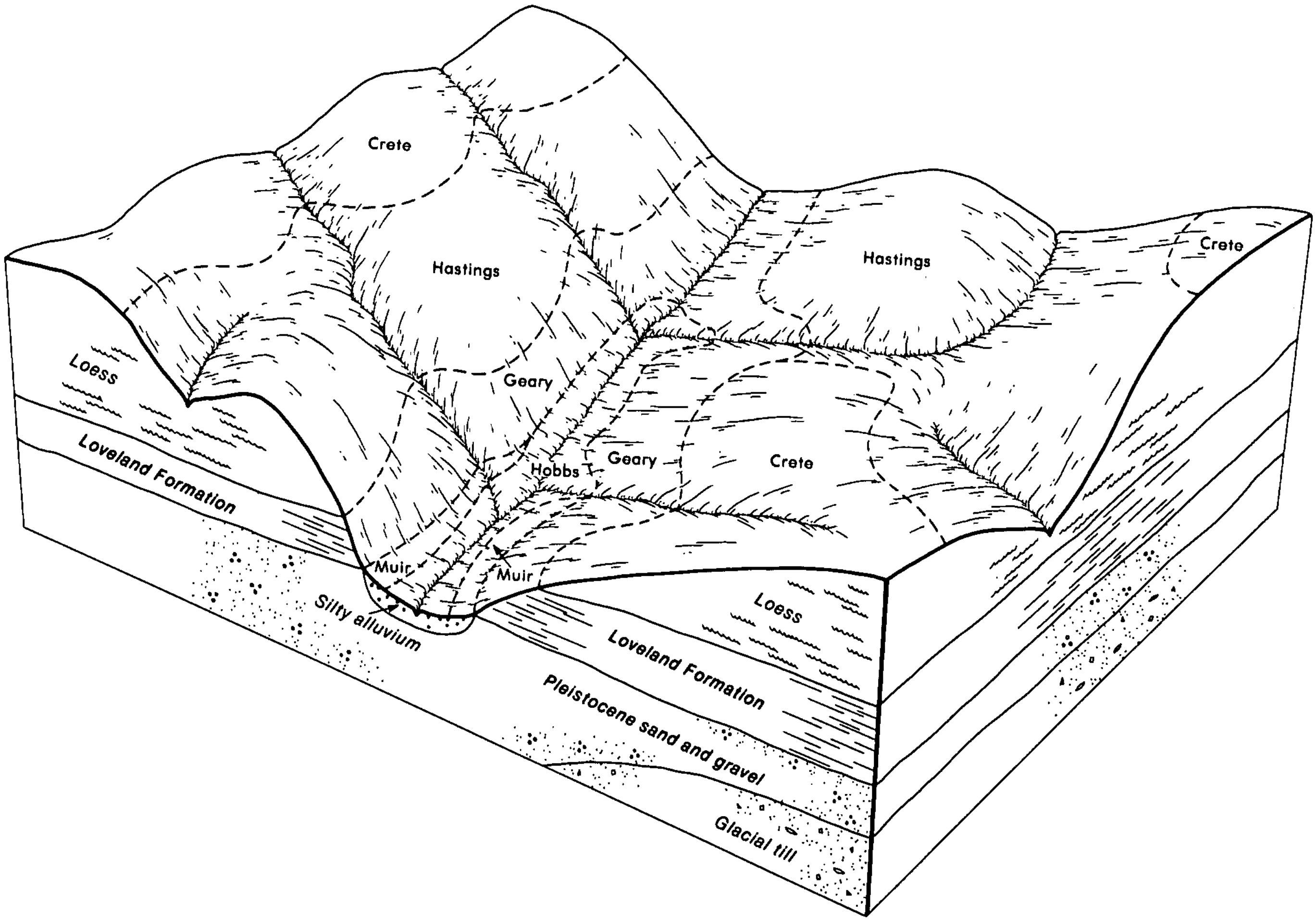


Figure 6.—Typical pattern of soils, topography, and parent material in the Hastings-Crete-Geary association.

management concern on the eroded soils. Irrigation is limited because of the strongly sloping to steep soils. Proper grazing use is a management concern on range.

Farms in areas of this association average about 320 acres in size. Paved highways cross parts of this association. A few sources of sand and gravel are in areas of the Geary soils. Grain and other farm products are sold mainly in the county and in nearby markets, such as Tobias, in Saline County; Bruning, in Thayer County; and Daykin, in Jefferson County. Livestock is marketed in Geneva and in nearby markets, such as Crete, in Saline County, and Hebron, in Thayer County.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Crete silt loam, 0 to 1 percent slopes, is one of several phases in the Crete series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Olbut-Butler silt loams, 0 to 1 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, gravel, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Some soil boundaries and soil names do not fully match those in surveys of adjoining areas that were published at an earlier date. Differences result from changes and refinements in series concepts, different slope groupings, and application of the latest soil classification system.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Soil Descriptions

Bu—Butler silt loam, 0 to 1 percent slopes. This deep, nearly level, somewhat poorly drained claypan soil is mostly in plane or slightly concave areas and basins on uplands and stream terraces. It formed in loess. The areas are in four main shapes: a ring around lower, wetter soils; the general shape of a teardrop, the point of which is near the head of the drainageways; an irregular shape; and somewhat oblong. Most areas range from 5 to 160 acres in size, but those in the broad basins range from 300 to 3,000 acres.

Typically, the surface layer is grayish brown and dark grayish brown, very friable silt loam about 11 inches thick. The subsurface layer is gray, very friable silt loam about 2 inches thick. The subsoil is silty clay about 21 inches thick. The upper part is dark gray and very firm, and the lower part is grayish brown, firm, and calcareous. The underlying material to a depth of about 60 inches is pale olive and pale yellow silty clay loam. It is calcareous in the upper part. In some narrow areas adjacent to more sloping soils, the surface layer is more than 14 inches thick because of colluvial or alluvial deposition. In a few broad basins, the surface layer is less than 6 inches thick. In some areas it has been mixed by tillage with the subsoil. In other areas lime is within a depth of 24 inches.

Included with this soil in mapping are small areas of Crete, Fillmore, Muir, and Olbut soils and small areas where land leveling has exposed the clayey subsoil. Crete soils do not have an abrupt boundary between the subsurface layer and subsoil and have dark brown layers in the subsoil. They are slightly higher on the landscape than this Butler soil and are better drained. Fillmore soils have a subsurface layer that is thicker than that of this Butler soil. They are in depressions and are more poorly drained than this Butler soil unless the drainage has been altered by land leveling. Muir soils have less clay in the subsoil than the Butler soil. They are well drained and are on stream terraces. Olbut soils contain soluble salts. They are slightly lower on the landscape than this Butler soil. Included soils make up as much as 15 percent of this unit.

Permeability is slow in this Butler soil, and the water intake rate for irrigation is low in the claypan subsoil. Available water capacity is high, but moisture is released slowly to plants. Runoff is slow. Water is ponded for brief periods following heavy rainfall. A perched seasonal high water table is at a depth of 0.5 foot to 3.0 feet. In areas that have not been leveled, tilth is good, organic matter content is moderate, and natural fertility is medium. Where the subsoil has been exposed by land leveling, however, organic matter content is low, tilth is poor, and the amount of available zinc is deficient. The shrink-swell potential is moderate in the surface layer and subsurface layer and high in the subsoil.

Most of the acreage is farmed. The rest is grassland used for grazing or wildlife habitat. Most of the farmed areas are irrigated, but some are used for dryland crops.

If used for dryland farming, this soil is suited to corn, grain sorghum, small grain, and grasses and legumes. Grain sorghum and small grain are better able to withstand the slow release of moisture from the claypan subsoil. Small grain, such as wheat, matures before the weather becomes hot and dry. Conservation tillage practices, such as till planting, chiseling, and disking, that keep all or part of the crop residue on the surface conserve soil moisture. Runoff from adjacent areas often ponds on this soil for a period ranging from a few hours to a few days, especially in the spring. The excess water delays tillage and may retard crop growth, but crop failures are infrequent. Terracing the adjacent higher areas slows the runoff rate on this soil. Puddling and compaction occur if this soil is tilled when wet. As the soil dries, it becomes hard and difficult to work. Returning crop residue and green manure crops to the soil and applying feedlot manure help to prevent crusting and compaction and improve fertility, tilth, and water infiltration. Including a deep-rooted legume, such as alfalfa, in the cropping sequence loosens compacted layers and the claypan subsoil, thereby improving water infiltration and fertility and tilth. Crop rotation interrupts weed, insect, and disease cycles. Leaving crop stubble standing on the surface throughout winter reduces snow and soil blowing in the cultivated areas.

If irrigated, this soil is suited to corn, grain sorghum, soybeans, and grasses and legumes. If a gravity system is used, land leveling improves surface drainage and helps to achieve a uniform distribution of water, but exposing the subsoil hinders tillage and seedling establishment. Adding zinc and organic matter improves fertility and tilth in areas that have been leveled. Conservation tillage practices, such as chiseling and disking, that leave crop residue on the surface also improve tilth in those areas and conserve soil moisture. Sprinkler irrigation helps seedlings penetrate a crusted surface layer. Using a water application rate suited to the low intake rate of this soil reduces runoff of irrigation water. For example, if a gravity system is used, applying water often and in long runs helps to prevent excessive runoff. Tailwater recovery systems conserve irrigation water and improve the efficiency of water application (fig. 7).

This soil is suited to pasture and hay, which can be rotated with other crops. A cover of introduced grasses, generally bromegrass or a mixture of bromegrass and alfalfa, is effective in improving tilth and the water intake rate. Overgrazing reduces the extent of the protective plant cover, and grazing when the soil is too wet compacts the surface layer, slowing water infiltration and injuring the crowns of the plants. Proper stocking rates, rotation grazing, timely applications of nitrogen fertilizer, and restricted grazing during wet periods keep the plants and the soil in good condition.

This soil is suited to range. A cover of range plants is very effective in maintaining tilth and in improving the water intake rate. The native plant community is mostly mid and tall grasses dominated by big bluestem, indiangrass, little bluestem, porcupinegrass, and switchgrass. When the plants are overgrazed or improperly harvested for hay, big bluestem, indiangrass, and switchgrass decrease in abundance and sideoats grama, tall dropseed, Kentucky bluegrass, and annual and perennial weeds increase. If overgrazing continues for many years, the abundance of the less desirable plants, especially Kentucky bluegrass, buckbrush, snowberry, and sumac, increases. Restricted grazing during wet periods helps keep the range plants in good condition.

This soil is suited to the trees grown as windbreaks, but the trees selected for planting should be able to withstand occasional wetness. Establishing seedlings is difficult when the soil is wet. The site should be tilled and the seedlings planted when the soil is moist but not when it is wet. Because of the high shrink-swell potential, cracks form in the soil during dry periods, allowing air to dry out the roots of shallow-rooted seedlings. Light cultivation helps to prevent the formation of cracks at the surface, but supplemental water is

Figure 7.—A tailwater recovery pit in an area of Butler silt loam, 0 to 1 percent slopes.

needed to keep the subsoil from cracking or to close existing cracks.

Septic tank absorption fields do not function well in this soil because of the wetness and the slow permeability. Fill material is needed to raise the field a sufficient distance above the perched seasonal high water table. Enlarging the field helps to overcome the slow permeability. Otherwise, an alternative system can be installed. Using fill material on sites for sewage lagoons, dwellings, and local roads helps to avoid the effects of the seasonal high water table on those uses. Providing side ditches and culverts also helps to protect roads from wetness. Strengthening the foundations of buildings and backfilling with coarse material help to prevent the structural damage caused by shrinking and swelling. Roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to ensure better performance. Excessive damage to roads caused by frost action can be prevented by providing good surface drainage and by installing a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

This soil is assigned to capability units IIw-2, dryland and irrigated; pasture and hayland suitability group A-4; Clayey range site; and windbreak suitability group 2W.

By—Butler silty clay loam, 0 to 1 percent slopes. This deep, nearly level, somewhat poorly drained claypan soil is mostly in plane or slightly concave areas on uplands. In a few areas it is in broad basins. It formed in loess. Areas generally range from 5 to 125 acres in size. Some are in the shape of a teardrop, the point of which is near the head of drainageways. The other areas are irregular in shape.

Typically, the surface layer is dark grayish brown, firm silty clay loam about 4 inches thick. The subsoil is about 24 inches thick. The upper part is dark gray, very firm silty clay; the next part is dark grayish brown, very firm silty clay; and the lower part is grayish brown, firm, calcareous silty clay loam. The underlying material to a depth of about 60 inches is pale olive, friable, calcareous silt loam. In places the surface layer is silt loam and is thicker.

Included with this soil in mapping are small areas of Fillmore and Crete soils. Fillmore soils are lower on the landscape than this Butler soil, are poorly drained, and have a distinct, grayish subsurface layer. Crete soils are slightly higher on the landscape than this Butler soil, are better drained, and have a browner subsoil. Included soils make up as much as 15 percent of this unit.

Permeability is slow in this Butler soil, and the water intake rate for irrigation is very low. Available water capacity is high, but moisture is released slowly to plants. Runoff is slow. A perched seasonal water table is at a depth of 0.5 foot to 3.0 feet. Tilth is fair. The organic matter content is moderate, and natural fertility is medium. The shrink-swell potential is high in the surface layer and subsoil.

Most of the acreage is farmed. About half of the farmed acreage is irrigated. A few areas of grasses are used for grazing.

If used for dryland farming, this soil is suited to corn, grain sorghum, small grain, and grasses and legumes. Grain sorghum and small grain are better able to withstand the slow release of moisture from the claypan subsoil. Small grain, such as wheat, matures before the weather becomes hot and dry. Conservation tillage practices, such as till planting and disking, that keep all or part of the crop residue on the surface conserve soil moisture and help to prevent excessive soil blowing. Runoff from adjacent areas often ponds on this soil for a period ranging from a few hours to a few days, especially in the spring. The excess water delays tillage and may retard crop growth, but crop failures are infrequent. Terracing the adjacent higher areas reduces the runoff rate on this soil. Compaction and puddling occur if this soil is tilled when wet. As the soil dries, it becomes hard and cannot be easily worked. Therefore, tillage is limited to a narrow range of moisture content. Returning crop residue and green manure crops to the soil and applying feedlot manure increase the organic matter content, improve fertility, help to prevent crusting and compaction, and improve tilth and water infiltration. Including a deep-rooted legume, such as alfalfa, in the cropping sequence loosens compacted layers and the claypan subsoil, thereby improving water infiltration and fertility and tilth. Crop rotation interrupts weed, insect, and disease cycles. Leaving crop stubble standing throughout winter helps to prevent excessive soil blowing. Also, the stubble traps snow, thus increasing the supply of soil moisture.

If irrigated, this soil is suited to corn, grain sorghum, soybeans, and grasses and legumes. A gravity or sprinkler system of irrigation can be used on this soil. Land leveling improves surface drainage and helps to achieve a uniform distribution of water in areas irrigated by a gravity system, but exposing the subsoil hinders tillage and seedling establishment. Less land preparation is needed if a sprinkler system is used. Adding organic matter and zinc improves fertility and tilth in areas that have been leveled. Conservation tillage practices, such as till planting and disking, that leave crop residue on the surface also improve tilth in those areas and conserve soil moisture. Timely application and efficient distribution of water are needed to obtain maximum benefit from a gravity or sprinkler system. If a gravity system is used, a tailwater recovery system can be constructed to conserve water.

This soil is suited to pasture or hay, which can be rotated with other crops. Introduced grasses, generally smooth bromegrass or orchardgrass, are suitable. They can be used alone or in a mixture with legumes, such as alfalfa. A cover of these plants is effective in controlling water erosion. Overgrazing reduces the extent of the protective plant cover, lowers the quality of native plants, and increases the runoff rate and the susceptibility to erosion. Also, overgrazing or grazing when the soil is wet causes compaction and poor tilth.

This soil is suited to range. A cover of range plants is very effective in improving tilth and the water intake rate. The native plant community is mostly mid and tall grasses dominated by big bluestem, indiangrass, little bluestem, porcupinegrass, and switchgrass. When the plants are overgrazed or improperly harvested for hay, big bluestem, little bluestem, indiangrass, and switchgrass decrease in abundance and sideoats grama, tall dropseed, Kentucky bluegrass, and annual and perennial weeds increase. If overgrazing continues for many years, the abundance of the less desirable plants, especially Kentucky bluegrass, buckbrush, snowberry, and sumac, increases.

This soil is suited to the trees grown as windbreaks, but the trees selected for planting should be able to withstand occasional wetness. Establishing seedlings is difficult when the soil is wet. Competing vegetation can be removed by timely control measures. Light cultivation can reduce the extent of surface cracks. Supplemental watering closes cracks, protects roots, and provides needed water during periods of low rainfall.

Septic tank absorption fields do not function well in this soil because of the wetness and the slow permeability. Fill material is needed to raise the field a sufficient distance above the perched seasonal high water table. Enlarging the field helps to overcome the slow permeability. Otherwise, an alternative system can be installed. Using fill material on sites for sewage lagoons, dwellings, and local roads helps to avoid the effects of the perched seasonal high water table on those uses. Providing side ditches and culverts also helps to protect roads from wetness. Lining or sealing the sewage lagoons helps to prevent seepage. Strengthening the foundations of buildings and backfilling with coarse material help to prevent the structural damage caused by shrinking and swelling. Roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base

material helps to ensure better performance. Excessive damage to roads caused by frost action can be prevented by providing good surface drainage and by installing a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

This soil is assigned to capability units IIw-2, dryland, and IIw-1, irrigated; pasture and hayland suitability group A-4; Clayey range site; and windbreak suitability group 2W.

Ce—Crete silt loam, 0 to 1 percent slopes. This deep, nearly level, moderately well drained claypan soil is on slightly convex, plane, and slightly concave divides in the uplands. It formed in loess. The slightly concave areas are mostly near the head of drainageways. The areas of this unit are mainly irregular in shape and range from 10 to 3,000 acres in size.

Typically, the surface layer is grayish brown, very friable silt loam about 7 inches thick. The subsurface layer is grayish brown, very friable silty clay loam about 5 inches thick. The subsoil is about 31 inches thick. The upper part is dark brown, very firm silty clay; the next part is brown, very firm silty clay; and the lower part is light yellowish brown, friable, calcareous silty clay loam. The underlying material to a depth of about 60 inches is light yellowish brown, calcareous silty clay loam. In some areas the surface layer is less than 5 inches thick because land leveling and tillage have mixed it with the upper part of the subsoil. In places the dark upper part of the soil is less than 20 inches thick.

Included with this soil in mapping are small areas of Butler, Fillmore, Hastings, and Olbut soils and small areas where the subsoil or underlying material has been exposed by land leveling. Butler, Fillmore, and Olbut soils are lower on the landscape than this Crete soil and are more poorly drained. They have an abrupt boundary between the surface layer and the layer beneath it and have dark gray subsoil layers. Butler and Fillmore soils have a distinct, gray subsurface layer. Olbut soils contain soluble salts. In most areas of Fillmore soils, the surface has been covered with fill material and surface drainage has been improved. Hastings soils have less clay in the subsoil than this Crete soil. They are in positions on the landscape similar to those of this Crete soil but are better drained. Included soils make up as much as 15 percent of this unit.

Permeability is slow in this Crete soil, and the water intake rate for irrigation is low in the claypan subsoil. Available water capacity is high, but moisture is released slowly to plants. Runoff is slow. Tilth is good in the very friable surface layer. This layer is moderate in organic matter content, and medium in natural fertility. In leveled areas where the subsoil is at the surface, the organic matter content is low, tilth is poor, and the amount of available zinc is deficient. The shrink-swell potential is moderate in the surface layer and high in the subsoil.

Most of the acreage is farmed. Most farmed areas are irrigated. A few areas of grasses are used for grazing and hay.

If used for dryland farming, this soil is suited to small grain, grain sorghum, corn, and grasses and legumes. Grain sorghum and small grain can withstand the slow release of moisture from the claypan subsoil. Small grain, such as wheat, matures before the weather becomes hot and dry. Conservation tillage practices, such as till planting, chiseling, and disking, that leave crop residue on the surface conserve soil moisture. The surface layer is often saturated in the spring. As a result, tillage is delayed. Puddling and compaction occur if this soil is tilled when wet. As the soil dries, it becomes hard and difficult to work. Returning crop residue to the soil, planting green manure crops, and applying feedlot manure increase the organic matter content, improve fertility, help to prevent crusting and compaction, and improve tilth and water infiltration. Including a deep-rooted legume, such as alfalfa, in the cropping sequence loosens compacted layers and the claypan subsoil, thereby improving water infiltration and fertility and tilth. Crop rotation interrupts weed, insect, and disease cycles. Leaving crop stubble standing throughout winter helps to prevent excessive soil blowing. Also, the stubble traps snow, thus providing additional soil moisture.

If irrigated, this soil is suited to corn, grain sorghum, soybeans, and grasses and legumes. If a gravity system is used, land leveling improves surface drainage and helps to achieve a uniform distribution of water. If leveling the land exposes the subsoil, however, tillage and seedling establishment are difficult. Adding zinc and organic matter can improve fertility and tilth in the leveled areas. Conservation tillage practices, such as chiseling and disking, that leave crop residue on the surface also improve tilth of those areas and conserve soil moisture. Sprinkler irrigation can soften a crusted surface and thus can facilitate the emergence of seedlings. Using a water application rate suited to the low intake rate of this soil conserves irrigation water. For example, if a gravity system is used, the water should be applied frequently and in long runs. If a gravity system is used, a tailwater recovery system reduces the runoff rate and improves the efficiency of water application.

This soil is suited to pasture and hay, which can be rotated with other crops. Introduced grasses, generally smooth bromegrass or orchardgrass, are suitable. They can be used alone or in a mixture with legumes, such as alfalfa. A cover of these plants is effective in controlling water erosion. Overgrazing reduces the extent of the protective plant cover, lowers the quality of native plants, and increases the runoff rate and the susceptibility to erosion. Also, overgrazing or grazing when the soil is wet causes compaction and poor tilth.

This soil is suited to range. A cover of range plants is very effective in improving tilth and the water intake rate. The native plant community is mostly mid and tall grasses dominated by big bluestem, indiangrass, little bluestem, porcupinegrass, and switchgrass. When the plants are overgrazed or improperly harvested for hay, big bluestem, little bluestem, indiangrass, and switchgrass decrease in abundance and sideoats grama, tall dropseed, Kentucky bluegrass, and annual and perennial weeds increase. If overgrazing continues for many years, the abundance of the less desirable plants, especially Kentucky bluegrass, buckbrush, snowberry, and sumac, increases.

This soil is suited to the moderately drought resistant trees grown as windbreaks. If competing vegetation is removed by good site preparation and timely control measures, the seedlings generally survive. Because of the high shrink-swell potential, cracks form in the soil during dry periods, allowing air to dry out the roots of seedlings. Light cultivation can reduce the extent of surface cracks, but supplemental water is needed to keep the subsoil from cracking or to close existing cracks.

Septic tank absorption fields do not function well in this soil because of the slow permeability. Enlarging the absorption field helps to overcome this limitation. Otherwise, an alternative system can be installed. Lining or sealing sewage lagoons helps to prevent seepage. Strengthening the foundations of dwellings and backfilling with coarse material help to prevent the structural damage caused by shrinking and swelling. Roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to ensure better performance. Mixing the base material with additives, such as hydrated lime, helps to prevent shrinking and swelling.

This soil is assigned to capability units IIs-2, dryland and irrigated; pasture and hayland suitability group A-4; Clayey range site; and windbreak suitability group 4L.

CeB—Crete silt loam, 1 to 3 percent slopes. This deep, very gently sloping, moderately well drained claypan soil is on the ridges of divides and the sides of drainageways in the uplands. It formed in loess. Areas are irregular in shape and range from 5 to more than 2,000 acres in size.

Typically, the surface layer is gray, very friable silt loam about 7 inches thick. The subsoil is about 23 inches thick. The upper part is dark gray, friable silty clay loam; the next part is brown and grayish brown, very firm silty clay; and the lower part is light yellowish brown, firm, calcareous silty clay loam. The underlying material to a depth of about 60 inches is very pale brown, calcareous silt loam. In some cultivated areas the surface layer has more clay because it has been mixed with the upper part of the subsoil by tillage. In places the dark upper part of the soil is less than 20 inches thick and the thickness of the surface layer combined with that of the subsoil is less than 30 inches. In some areas lime is within a depth of 25 inches.

Included with the soil in mapping are small areas of Butler, Fillmore, and Hastings soils and small areas of eroded soils. Butler and Fillmore soils have a distinct, gray subsurface layer. They are in depressions. Hastings soils have less clay in the subsoil than the Crete soil. They are well drained and are in positions on the landscape similar to those of the Crete soil. The eroded soils have a silty clay surface layer. They are lighter in color than this Crete soil because the subsoil or underlying material is exposed. The eroded areas have a silty clay surface layer. Included soils make up 15 percent or less of this unit.

Permeability is slow in the Crete soil, and the water intake rate for irrigation is low. Available water capacity is high, but moisture is released slowly to plants. Runoff is medium. The very friable surface layer generally is moderate in content of organic matter and medium in natural fertility and has good tilth. In eroded areas, however, organic matter content is low, tilth is poor, and the amount of available phosphates is deficient. The shrink-swell potential is moderate in the surface layer and high in the subsoil.

Most of the acreage is farmed. Most of the farmed areas are irrigated. Some do not have ground water available for irrigation, however, and are used for dryland farming. A few areas of grasses are used for grazing and hay.

If used for dryland farming, this soil is suited to small grain, grain sorghum, and grasses and legumes (fig. 8). It is only moderately well suited to corn. Grain sorghum and small grain can withstand the slow release of moisture from the claypan subsoil. Also, small grain, such as wheat, matures before the weather becomes hot and dry. Water erosion can be controlled by terraces, contour farming, grassed waterways, and conservation tillage practices that leave crop residue on the surface. Conservation tillage also helps to control soil blowing and conserves soil moisture. Summer fallowing conserves moisture. Puddling and compaction occur if the soil is tilled when too wet. After drying, the soil is hard and cannot be easily worked, especially in eroded areas. Delaying tillage until the soil moisture content is low enough helps to prevent puddling and compaction. Returning crop residue and green manure crops to the soil and applying feedlot manure increase the organic matter content, improve fertility, and help to prevent crusting and compaction. Also, they improve tilth and water infiltration, especially in the eroded areas. Including a deep-rooted legume, such as alfalfa, in the cropping sequence loosens compacted layers and the claypan subsoil, thereby improving water movement, fertility, and tilth. Rotation of crops interrupts weed, insect, and disease cycles. Leaving crop stubble

standing throughout the winter helps to trap snow and thus increases the supply of soil moisture.

If irrigated, this soil is suited to corn, grain sorghum, soybeans, and grasses and legumes. Sprinkler or gravity irrigation systems can be used on this soil. Adjusting the water application rate to the low water intake rate of the soil aids in reducing runoff of irrigation water. If a gravity system is used, contour bench leveling is needed to establish a suitable grade and thus to control water erosion and a tailwater recovery system is needed to conserve irrigation water and improve the efficiency of water application. Conservation tillage practices, such as chiseling and disking, leave crop residue on the surface and thus prevent excessive water erosion and soil blowing and conserve soil moisture. Additions of organic matter and phosphates improve fertility and tilth in eroded areas.

This soil is suited to pasture and hay, which can be rotated with other crops. Introduced grasses, generally smooth bromegrass or orchardgrass, are suitable, either alone or in a mixture with legumes, such as alfalfa. A cover of these grasses is effective in controlling water erosion. Overgrazing reduces the extent of the protective vegetative cover, lowers the quality of native plants, and increases the runoff rate and the susceptibility to erosion. Also, overgrazing or grazing when the soil is wet causes compaction and poor tilth.

This soil is suited to range. A cover of range plants is very effective in controlling water erosion. The native plant community is mostly mid and tall grasses dominated by big bluestem, indiangrass, little bluestem, porcupinegrass, and switchgrass. When the plants are overgrazed or improperly harvested for hay, big bluestem, little bluestem, indiangrass, and switchgrass decrease in abundance and sideoats grama, tall dropseed, Kentucky bluegrass, and annual and perennial weeds increase. If overgrazing continues for many years, the less desirable plants, especially Kentucky bluegrass, buckbrush, snowberry, and sumac, increase in abundance.

This soil is suited to the moderately drought resistant trees grown as windbreaks. Because of the hazard of water erosion, the trees should be planted on the contour if possible. If competing vegetation is removed by good site preparation and by timely control measures, the seedlings generally survive. Because of the high

Figure 8.—Dryland grain sorghum and summer fallow in an area of Crete silt loam, 1 to 3 percent slopes.

shrink-swell potential, cracks form during dry periods, allowing air to dry out the roots of seedlings. Light cultivation can reduce the extent of surface cracking, but supplemental water is needed to reduce the extent of cracking in the subsoil or to close existing cracks.

Septic tank absorption fields do not function well in this soil because of the slow permeability. Enlarging the absorption field helps to overcome this limitation. Otherwise, an alternative system can be installed. On sites for sewage lagoons, some grading is needed to modify the slope and shape the lagoon. Also, lining or sealing the lagoon helps to prevent seepage. Strengthening the foundations of dwellings and backfilling with coarse material help to prevent the structural damage caused by shrinking and swelling. Local roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to ensure better performance. Mixing the base material with additives, such as hydrated lime, helps to prevent shrinking and swelling.

This soil is assigned to capability units IIe-2, dryland and irrigated; pasture and hayland suitability group A-4; Clayey range site; and windbreak suitability group 4L.

CeC—Crete silt loam, 3 to 6 percent slopes. This deep, gently sloping, moderately well drained claypan soil is mostly on the sides of upland drainageways. In some areas it is on narrow, convex divides between steep upland drainageways or on side slopes of upland breaks to stream terraces or bottom lands. The soil is formed in loess. Areas are irregular in shape or somewhat oblong and range from 5 to 40 acres in size.

Typically, the surface layer is grayish brown, very friable silt loam about 8 inches thick. The subsoil is about 19 inches thick. The upper part is grayish brown, friable silty clay loam; the next part is dark grayish brown and grayish brown, very firm silty clay; and the lower part is olive, firm, calcareous silty clay loam. The underlying material extends to a depth of about 60 inches. It is calcareous. It is pale olive, friable silty clay loam in the upper part and pale yellow, very friable silt loam in the lower part. In some areas the surface layer is silty clay loam. In other areas lime is within a depth of 25 inches.

Included with this soil in mapping are small areas of Geary, Hastings, and Hobbs soils. Also included are severely eroded areas where the subsoil or underlying material is exposed. Geary soils have less clay in the subsoil than this Crete soil and are on the lower side slopes. Hastings soils have less clay in the subsoil than this Crete soil and are better drained. They are in landscape positions similar to those of this Crete soil. Hobbs soils are stratified and are at the bottoms of drainageways. Included soils make up as much as 15 percent of this unit.

Permeability is slow in this Crete soil, and the water intake rate is low. Available water capacity is high, but moisture is released slowly to plants. Runoff is medium. The surface layer generally is moderate in organic matter content, is medium in natural fertility, and has good tilth. In eroded areas, however, tilth is poor, organic matter content is low, and the amount of available phosphates is deficient. The shrink-swell potential is moderate in the surface layer and high in the subsoil.

Most of the acreage is grassland used for grazing and hay. A few acres are farmed.

If used for dryland farming, this soil is suited to small grain, grain sorghum, and grasses and legumes. Grain sorghum and small grain can withstand the slow release of moisture from the claypan. Small grain, such as wheat, matures before the weather becomes hot and dry. Water erosion and runoff can be controlled by terraces, contour farming, grassed waterways, and conservation tillage practices that leave crop residue on the surface. Conservation tillage practices also conserve moisture. Leaving crop stubble standing throughout winter helps to control soil blowing. Also, the stubble traps blowing snow, thus providing additional soil moisture. Including close-growing crops, such as wheat, alfalfa, or grasses, in the cropping system helps to control erosion and improves tilth and water infiltration. Returning crop residue and green manure crops to the soil and applying feedlot manure increase the organic matter content, and improve fertility, tilth, and water infiltration. Additional phosphates are needed in eroded areas.

If irrigated, this soil is suited to grasses and legumes, such as alfalfa. If erosion is controlled, the soil is suited to irrigated corn, grain sorghum, and soybeans. A sprinkler system is the best method of irrigating this soil, but adjacent steep slopes commonly limit its use. Contour bench leveling helps to control runoff in some of the less sloping areas irrigated by a gravity system, but erosion and runoff are difficult to control because of the slope. In areas irrigated by a center-pivot sprinkler system, grass-covered terraces help to intercept runoff and prevent excessive erosion, especially in wheel tracks. The grass on the terraces keeps the wheels from making deep furrows in the soil. Leaving crop residue on the surface by using such conservation tillage practices as till planting helps to control erosion when the soil is irrigated. The rate of water application should be adjusted to the low intake rate of the soil.

This soil is suited to pasture and hay, which can be rotated with other crops. Introduced grasses, generally smooth bromegrass or orchardgrass, are suitable. They can be used alone or in a mixture with legumes, such as alfalfa. A cover of these plants is effective in controlling water erosion. Overgrazing reduces the extent of the protective plant cover, lowers the quality of native plants, and increases the runoff rate and the susceptibility to

erosion. Also, overgrazing or grazing when the soil is wet causes compaction and poor tilth.

This soil is suited to range. A cover of range plants is very effective in controlling water erosion. The native plant community is mostly mid and tall grasses dominated by big bluestem, indiangrass, little bluestem, porcupinegrass, and switchgrass. When the plants are overgrazed or improperly harvested for hay, big bluestem, little bluestem, indiangrass, and switchgrass decrease in abundance and sideoats grama, tall dropseed, Kentucky bluegrass, and annual and perennial weeds increase. If overgrazing continues for many years, the abundance of the less desirable plants, especially Kentucky bluegrass, buckbrush, and sumac, increases.

This soil is suited to the moderately drought resistant trees grown as windbreaks. Where practical, planting the trees on the contour helps to save moisture and prevent excessive runoff and erosion. If competing vegetation is removed by good site preparation and timely control measures, the seedlings generally survive. Because of the high shrink-swell potential, cracks form in the soil during dry periods, allowing air to dry out the roots of seedlings. Light cultivation and applications of supplemental water close the cracks and protect the roots.

Septic tank absorption fields do not function well in this soil because of the slow permeability. Enlarging the absorption field helps to overcome this limitation. Otherwise, an alternative system can be installed. On sites for sewage lagoons, moderate grading is needed to modify the slope and shape the lagoon. Lining or sealing the lagoon helps to prevent seepage. Strengthening the foundations of dwellings and backfilling with coarse material help to prevent the structural damage caused by shrinking and swelling. Local roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarse grained base material helps to ensure better performance. Mixing the base material with additives, such as hydrated lime, helps to prevent shrinking and swelling.

This soil is assigned to capability units IIIe-2, dryland and irrigated; pasture and hayland suitability group A-4; Clayey range site; and windbreak suitability group 4L.

Cr—Crete silty clay loam, 0 to 1 percent slopes. This deep, nearly level, moderately well drained claypan soil is on slightly convex and plane divides in the uplands. It formed in loess. Areas are irregular in shape and range from 5 to 200 acres in size.

Typically, the surface layer is dark grayish brown, firm silty clay loam about 6 inches thick. The subsoil is about 22 inches thick. The upper part is dark grayish brown, very firm silty clay; the next part is mixed dark grayish brown and grayish brown, very firm silty clay; and the lower part is light olive brown, firm, calcareous silty clay loam. The underlying material to a depth of about 60 inches is light yellowish brown, friable and very friable, calcareous silty clay loam. In some areas the dark upper part of the soil is more than 20 inches thick. In a few areas land leveling has exposed the subsoil or underlying material.

Included with this soil in mapping are small areas of Butler and Fillmore soils. These soils have dark gray layers in the subsoil and have a distinct, gray subsurface layer. They are lower on the landscape than this Crete soil and are more poorly drained. In some areas of the Fillmore soils, the surface has been covered with fill material and surface drainage has been improved. Included soils make up as much as 10 percent of this unit.

Permeability is slow in this Crete soil, and the water intake rate for irrigation is very low. Available water capacity is high, but moisture is released slowly to plants. Runoff is slow. Generally, tilth is fair, organic matter content is moderate, and natural fertility is medium. In land-leveled areas, however, organic matter content is low, tilth is poor, and the amount of available zinc is deficient. The shrink-swell potential is high in the surface layer and subsoil.

Most of the acreage is farmed. About half is used for irrigated crops and half for dryland crops. A few areas of native grasses are used for grazing and hay.

If used for dryland farming, this soil is suited to grain sorghum, small grain, corn, and grasses and legumes. Grain sorghum and small grain can withstand the slow release of moisture from the claypan subsoil. Small grain, such as wheat, matures before the weather becomes hot and dry. Conservation tillage practices, such as till planting and disking, that leave crop residue on the surface conserve soil moisture. This soil is difficult to work because the surface layer is silty clay loam. Compaction and puddling occur if the soil is tilled when wet. As it dries, the soil becomes hard and cannot be easily worked. Therefore, tillage is limited to a narrow range of moisture content. Returning crop residue and green manure crops to the soil and applying feedlot manure increase the organic matter content, improve fertility, and help to prevent crusting and compaction. They also improve tilth and water infiltration, especially in the eroded and gumbo areas. Including a deep-rooted legume, such as alfalfa, in the cropping sequence loosens compacted layers and the claypan subsoil, thereby improving water infiltration and fertility and tilth. Crop rotation interrupts weed, insect, and disease cycles. Leaving crop stubble standing throughout winter helps to prevent excessive soil blowing. Also, the stubble traps snow, thus providing additional soil moisture.

If irrigated, this soil is suited to corn, grain sorghum, soybeans, and grasses and legumes. A gravity or sprinkler system of irrigation can be used on this soil. In areas irrigated by a gravity system, land leveling improves surface drainage and helps to achieve a uniform distribution of water. Care must be taken,

however, to avoid exposing the subsoil. Less land leveling is needed if a sprinkler system is used. In areas that have been cut during land leveling, the organic matter content is low. It can be increased by returning crop residue to the soil. The amount of phosphorus and zinc commonly is deficient in these cut areas. Conservation tillage practices, such as chiseling and disking, that leave crop residue on the surface improve tilth in these areas and conserve soil moisture. Using a water application rate suited to the very low water intake rate of this soil conserves irrigation water. In areas irrigated by a gravity system, a tailwater recovery system also conserves water.

This soil is suited to pasture and hay, which can be rotated with other crops. Introduced grasses, generally smooth bromegrass or orchardgrass, are suitable. They can be used alone or in a mixture with legumes, such as alfalfa. A cover of these plants is effective in controlling water erosion. Overgrazing reduces the extent of the protective plant cover, lowers the quality of native plants, and increases the runoff rate and the susceptibility to erosion. Also, overgrazing or grazing when the soil is wet causes compaction and poor tilth.

This soil is suited to range. A cover of range plants is very effective in improving the water intake rate and tilth. The native plant community is mostly mid and tall grasses dominated by big bluestem, indiangrass, little bluestem, porcupinegrass, and switchgrass. When the plants are overgrazed or improperly harvested for hay, big bluestem, little bluestem, indiangrass, and switchgrass decrease in abundance and sideoats grama, tall dropseed, Kentucky bluegrass, and annual and perennial weeds increase. If overgrazing continues for many years, the abundance of less desirable plants, especially Kentucky bluegrass, buckbrush, snowberry, and sumac, increases.

This soil is suited to the moderately drought resistant trees grown as windbreaks. If competing vegetation is removed by good site preparation and by timely control measures, the seedlings generally survive. Because of the high shrink-swell potential, cracks form in the soil during dry periods, allowing air to dry out the roots of seedlings. Light cultivation can reduce the extent of surface cracks. Supplemental watering closes cracks, protects the roots, and provides needed water during periods of low rainfall.

Septic tank absorption fields do not function well in this soil because of the slow permeability. Enlarging the absorption field helps to overcome this limitation. Otherwise, an alternative system can be installed. Lining or sealing sewage lagoons helps to prevent seepage. Strengthening the foundations of buildings and backfilling with coarse material help to prevent the structural damage caused by shrinking and swelling. Roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to ensure better performance. Mixing the base material with additives, such as hydrated lime, helps to prevent shrinking and swelling.

This soil is assigned to capability units IIs-2, dryland, and IIs-1, irrigated; pasture and hayland suitability group A-4; Clayey range site; and windbreak suitability group 4L.

CrB—Crete silty clay loam, 1 to 3 percent slopes. This deep, very gently sloping, moderately well drained claypan soil is on the ridges of divides and the sides of drainageways in the uplands. It formed in loess. Areas range from 5 to 400 acres in size.

Typically, the surface layer is dark grayish brown, firm silty clay loam about 6 inches thick. The subsoil is about 15 inches thick. The upper part is dark grayish brown, very firm silty clay; the next part is grayish brown, very firm silty clay; and the lower part is light brownish gray, firm, calcareous silty clay loam. The underlying material extends to a depth of 60 inches. It is calcareous. It is light gray, friable silty clay loam in the upper part and pale yellow, very friable silt loam in the lower part. In places the dark upper part of the soil is less than 20 inches thick. In a few areas erosion has removed the surface layer and exposed the silty clay subsoil.

Included with this soil in mapping are small depressional areas of Fillmore soils. These soils have a distinct, grayish subsurface layer and have dark gray layers in the subsoil. They make up as much as 10 percent of this unit.

Permeability is slow in this Crete soil, and the water intake rate for irrigation is very low. Available water capacity is high, but moisture is released slowly to plants. Runoff is medium. Generally, tilth is fair, organic matter content is moderate, and natural fertility is medium. In eroded areas, however, organic matter content is low, tilth is poor, and the amount of available phosphates is deficient. The shrink-swell potential is high in the surface layer and subsoil.

Most of the acreage is farmed. About half is used for irrigated crops and about half for dryland crops. A few areas of grasses are used for grazing and haying.

If used for dryland farming, this soil is suited to grain sorghum, small grain, corn, and grasses and legumes. Grain sorghum and small grain can withstand the slow release of moisture from the claypan subsoil. Small grain, such as wheat, matures before the weather becomes hot and dry. Terraces, contour farming, grassed waterways, and conservation tillage practices, such as till planting and disking, that leave crop residue on the surface conserve soil moisture and control water erosion. This soil is difficult to work because the surface layer is silty clay loam. Compaction and puddling occur if the soil is tilled when wet. As the soil dries, it becomes hard and cannot be easily worked. Therefore, tillage is limited to a narrow range of moisture content. Returning crop residue and green manure crops to the soil and

applying feedlot manure increase the organic matter content, improve fertility, and help to prevent crusting and compaction. They also improve tilth and water infiltration, especially in eroded areas. Including a deep-rooted legume, such as alfalfa, in the cropping sequence loosens compacted layers and the claypan subsoil, thereby improving water infiltration and fertility and tilth. Crop rotation interrupts weed, insect, and disease cycles. Leaving crop stubble standing throughout winter helps to prevent excessive soil blowing. Also, the stubble traps snow, thus providing additional soil moisture.

If irrigated, this soil is suited to corn, grain sorghum, soybeans, and grasses and legumes. A gravity or sprinkler system of irrigation can be used on this soil. If a gravity system is used, contour bench leveling is needed to control water erosion and a tailwater recovery system is needed to conserve water. Less land preparation is needed if a sprinkler system is used. Using an application rate suited to the very low water intake rate of this soil conserves irrigation water. Conservation tillage practices, such as till planting and disking, that leave crop residue on the surface help to prevent excessive water erosion and conserve soil moisture. Additions of organic matter and phosphates improve fertility and tilth in eroded areas.

This soil is suited to pasture and hay, which can be rotated with other crops. Introduced grasses, generally smooth bromegrass or orchardgrass, are suitable. They can be used alone or in a mixture with legumes, such as alfalfa. A cover of these plants is effective in controlling water erosion. Overgrazing reduces the extent of the protective plant cover, lowers the quality of native plants, and increases the runoff rate and the susceptibility to erosion. Also, overgrazing or grazing when the soil is wet causes compaction and poor tilth.

This soil is suited to range. A cover of range plants is very effective in controlling water erosion. The native plant community is mostly mid and tall grasses dominated by big bluestem, indiangrass, little bluestem, porcupinegrass, and switchgrass. When the plants are overgrazed or improperly harvested for hay, big bluestem, little bluestem, indiangrass, and switchgrass decrease in abundance and sideoats grama, tall dropseed, Kentucky bluegrass, and annual and perennial weeds increase. If overgrazing continues for many years, the abundance of the less desirable plants, especially Kentucky bluegrass, buckbrush, snowberry, and sumac, increases.

This soil is suited to the moderately drought resistant trees grown as windbreaks. If competing vegetation is removed by good site preparation and timely control measures, the seedlings generally survive. Where practical, planting on the contour helps to control water erosion and runoff and conserves moisture. Because of the high shrink-swell potential, cracks form in the soil during dry periods, allowing air to dry out the roots of seedlings. Light cultivation can reduce the extent of surface cracks. Supplemental watering closes cracks, protects the roots, and provides needed water during periods of low rainfall.

Septic tank absorption fields do not function well in this soil because of the slow permeability. Enlarging the absorption field helps to overcome this limitation. Otherwise, an alternative system can be installed. On sites for sewage lagoons, some grading is needed to modify the slope and shape the lagoon. Lining or sealing the lagoon helps to prevent seepage. Strengthening the foundations of buildings and backfilling with coarse material help to prevent the structural damage caused by shrinking and swelling. Roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarse grained base material helps to ensure better performance. Mixing the base material with additives, such as hydrated lime, helps to prevent shrinking and swelling.

This soil is assigned to capability units IIe-2, dryland, and IIe-1, irrigated; pasture and hayland suitability group A-4; Clayey range site; and windbreak suitability group 4L.

CrC2—Crete silty clay loam, 3 to 6 percent slopes, eroded. This deep, gently sloping, moderately well drained soil is mainly on the short sides of upland drainageways and on the rolling hills of upland divides. In some areas it is on the side slopes of upland breaks to stream terraces. The soil formed in loess. Rills and small gullies are common. Areas are somewhat oblong or irregular in shape and range from 5 to about 480 acres in size.

Typically, the surface layer is grayish brown, firm silty clay loam about 5 inches thick. In most areas erosion has removed some or all of the original dark surface layer, and in places it has removed part of the subsoil. The part of the original surface layer that has not been removed has been mixed by tillage with the upper part of the subsoil. The subsoil is about 23 inches thick. The upper part is dark brown and brown, very firm silty clay, and the lower part is light yellowish brown, firm, calcareous silty clay loam. The underlying material to a depth of about 60 inches is very pale brown, calcareous silt loam. In a few areas the surface layer is silt loam. In a few places erosion has exposed the underlying material. In some areas lime is at the surface.

Included with this soil in mapping are small areas of eroded Geary soils, eroded Hastings soils, and Hobbs soils. Geary and Hastings soils have less clay in the subsoil than this Crete soil. Also, they are more sloping and better drained. Their positions on the landscape are similar to those of the Crete soil. Hobbs soils are stratified and are at the bottoms of drainageways. Included soils make up as much as 10 percent of this unit.

Permeability is slow in this Crete soil. Available water capacity is high, but moisture is released slowly to plants and the water intake rate for irrigation is very low. Runoff is medium. Natural fertility also is medium, and organic matter content is low. The amount of available phosphates is deficient. Tilth is poor because the organic matter content is low and the surface layer is silty clay loam. The shrink-swell potential is high. The surface layer is medium acid to mildly alkaline, depending on the extent of erosion.

Nearly all of the acreage is farmed. Most of the farmed areas are irrigated. A few areas have been reseeded to introduced or native grasses used for grazing and hay.

If used for dryland farming, this soil is suited to small grain, grain sorghum, and grasses and legumes. Water erosion is the main hazard. Terraces, contour farming, and grassed waterways help to control the runoff that causes the formation of rills and gullies. Conservation tillage practices, such as stubble mulching and till planting, that leave crop residue on the surface help to control water erosion and conserve soil moisture. Leaving crop stubble standing on the surface throughout winter helps to control soil blowing. Also, the stubble traps blowing snow, thus providing additional soil moisture. This soil puddles after hard rains or if it is worked when wet, and it becomes hard when dry. Therefore, tillage is limited to a narrow range of moisture content. A cropping system dominated by close-growing crops, such as wheat, alfalfa, or grasses, improves tilth and water infiltration and helps to control erosion. Returning crop residue and green manure crops to the soil and applying feedlot manure increase the organic matter content and improve natural fertility, tilth, and water infiltration. Phosphorus is needed if alfalfa is grown.

If irrigated, this soil is suited to grasses and to such legumes as alfalfa. If erosion is controlled, the soil is suited to irrigated corn, grain sorghum, and soybeans. A sprinkler system is the best method of irrigating this soil. Contour bench leveling helps to control runoff in some of the less sloping areas, but runoff and erosion are difficult to control because of the slope. In areas irrigated by a center-pivot sprinkler system, grass-covered terraces help to intercept runoff and prevent excessive erosion, especially in wheel tracks. The grass on the terraces keeps the wheels from making deep furrows in the soil. The rate of water application should be adjusted to the very low water intake rate of this soil. Leaving crop residue on the surface by using such conservation tillage practices as till planting and disking helps to control erosion and conserves soil moisture.

This soil is suited to pasture and hay, which can be alternated with other crops as part of the crop rotation. A cover of introduced grasses, generally bromegrass or a mixture of bromegrass and alfalfa, are effective in reducing the hazard of water erosion. Overgrazing reduces the extent of the protective plant cover, lowers the quality of the plants, and increases the runoff rate and the susceptibility to erosion. Proper stocking rates, rotation grazing, and timely applications of nitrogen and phosphorus fertilizer keep the grasses and soil in good condition.

This soil is suited to range. A cover of range plants is very effective in controlling water erosion. The native plant community is mostly mid and tall grasses dominated by big bluestem, indiangrass, little bluestem, porcupinegrass, and switchgrass. When the plants are overgrazed or improperly harvested for hay, big bluestem, little bluestem, indiangrass, and switchgrass decrease in abundance and sideoats grama, tall dropseed, Kentucky bluegrass, and annual and perennial weeds increase. If overgrazing continues for many years, the abundance of the less desirable plants, especially Kentucky bluegrass, buckbrush, snowberry, and sumac, increases. Proper grazing use, a planned grazing system, and deferred grazing keep the range in good condition.

This soil is suited to the moderately drought tolerant trees grown as windbreaks. If competing plants are removed by good site preparation and timely control measures, seedlings generally survive. Planting the rows of trees on the contour or planting a cover crop between the rows reduces the water erosion hazard. Some seedlings require supplemental water during dry periods.

Septic tank absorption fields do not function well in this soil because of the slow permeability. Enlarging the absorption field helps to overcome this limitation. Otherwise, an alternative system can be installed. On sites for sewage lagoons, some grading is needed to modify the slope and shape the lagoon. Lining or sealing the lagoon helps to prevent seepage. Strengthening the foundations of dwellings and backfilling with coarse material help to prevent the structural damage caused by shrinking and swelling. Roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to ensure better performance. Mixing the base material with additives, such as hydrated lime, helps to prevent shrinking and swelling.

This soil is assigned to capability units IIIe-8, dryland, and IIIe-1, irrigated; pasture and hayland suitability group A-4; Clayey range site; and windbreak suitability group 4L.

Ct—Crete silt loam, thick solum, 0 to 1 percent slopes. This deep, nearly level, moderately well drained soil is on slightly convex uplands and in a few slightly concave areas in basins between more sloping soils and more poorly drained soils. The soil formed in loess. Areas are mostly broad and irregular in shape and range from 20 to 1,000 acres in size.

Typically, the surface layer is dark grayish brown, very friable silt loam about 9 inches thick. The subsurface

layer is very dark grayish brown, very friable silt loam about 4 inches thick. The subsoil is about 37 inches thick. The upper part is dark grayish brown, friable silty clay loam; the next part is dark grayish brown and grayish brown, firm silty clay; and the lower part is light yellowish brown and pale yellow, firm silty clay loam. The underlying material to a depth of about 60 inches is pale yellow silt loam. In some areas the surface layer is less than 5 inches thick because of cuts made during land leveling. In these areas tillage has mixed the surface layer with the upper part of the subsoil.

Included with this soil in mapping are small areas of Butler, Fillmore, and Hastings soils and small areas where land leveling has exposed the subsoil or underlying material. Hastings soils have less clay in the subsoil than this Crete soil. They are in positions on the landscape similar to those of this Crete soil but are better drained. Butler and Fillmore soils are lower on the landscape than this Crete soil and are more poorly drained. They have an abrupt boundary between the surface layer or subsurface layer and the subsoil. They have dark gray layers in the subsoil and have a distinct, gray subsurface layer. In some areas of Fillmore soils, the surface has been covered with fill material and surface drainage has been improved. Included soils make up as much as 10 percent of this unit.

Permeability is slow in this Crete soil, and the water intake rate for irrigation is low in the subsoil. Available water capacity is high, but moisture is released slowly to plants. Runoff is slow. Generally, tilth is good in the very friable surface layer, and this layer is moderate in organic matter content and high in natural fertility. In some land-leveled areas, however, organic matter content is low, tilth is poor, and the amount of available zinc is deficient. The shrink-swell potential is moderate in the surface layer and high in the subsoil.

Nearly all of the acreage is farmed. Most farmed areas are irrigated. A few areas of grasses are used for grazing or wildlife habitat.

If used for dryland farming, this soil is suited to small grain, grain sorghum, and grasses and legumes. Grain sorghum and small grain are better able to withstand the slow release of moisture from the subsoil. Small grain, such as wheat, matures before the weather becomes hot and dry. Conservation tillage practices, such as till planting, that leave crop residue on the surface conserve soil moisture. Returning crop residue and green manure crops to the soil and applying feedlot manure increase the organic matter content, improve fertility, help to prevent crusting and compaction, and improve tilth and water infiltration. Including a deep-rooted legume, such as alfalfa, in the cropping sequence loosens compacted layers and the subsoil, thereby improving water infiltration and fertility and tilth. Crop rotation interrupts weed, insect, and disease cycles. Leaving crop stubble standing on the surface throughout winter helps to control soil blowing. Also, the stubble traps snow, thus providing additional soil moisture.

If irrigated, this soil is suited to corn, grain sorghum, soybeans, and grasses and legumes. In areas irrigated by a gravity system, land leveling improves surface drainage and helps to achieve a uniform distribution of water, but tillage and seedling establishment are difficult if the subsoil in exposed. Adding zinc and organic matter can improve fertility and tilth in the areas that have been leveled. Conservation tillage practices, such as till planting, that leave crop residue on the surface improve tilth and conserve soil moisture. Using an application rate suited to the low water intake rate of this soil helps to control runoff of irrigation water. For example, in areas irrigated by a gravity system, the water should be applied frequently and in long runs. If a gravity system is used, a tailwater recovery system controls runoff and improves the efficiency of water application.

This soil is suited to pasture and hay, which can be rotated with other crops. Introduced grasses, generally smooth bromegrass or orchardgrass, are suitable. They can be used alone or in a mixture with legumes, such as alfalfa. A cover of these plants is effective in controlling water erosion. Overgrazing reduces the extent of the protective plant cover, lowers the quality of native plants, and increases the runoff rate and the susceptibility to erosion. Also, overgrazing or grazing when the soil is wet causes compaction and poor tilth.

This soil is suited to range. A cover of range plants is very effective in improving the water intake rate and tilth. The natural plant community is mostly mid and tall grasses dominated by big bluestem, indiangrass, little bluestem, porcupinegrass, and switchgrass. When the plants are overgrazed or improperly harvested for hay, big bluestem, little bluestem, indiangrass, and switchgrass decrease in abundance and sideoats grama, tall dropseed, Kentucky bluegrass, and annual and perennial weeds increase. If overgrazing continues for many years, the abundance of the less desirable plants, especially Kentucky bluegrass, buckbrush, snowberry, and sumac, increases.

This soil is suited to the moderately drought resistant trees grown as windbreaks. If competing vegetation is controlled or removed by good site preparation and timely cultivation, the seedlings generally survive. Because of the shrink-swell potential, cracks form in the soil during dry periods, allowing air to dry out the roots of seedlings. Light cultivation after heavy rains can reduce the extent of surface cracking, but supplemental water is needed to prevent cracking in the subsoil or to close existing cracks.

Septic tank absorption fields do not function well in this soil because of the slow permeability. Enlarging the absorption field helps to overcome this limitation. Otherwise, an alternative system can be installed. Lining or sealing sewage lagoons helps to prevent seepage. Strengthening the foundations of buildings and backfilling

with coarse material help to prevent the structural damage caused by shrinking and swelling. Local roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to ensure better performance. Mixing the base material with additives, such as hydrated lime, helps to prevent shrinking and swelling.

This soil is assigned to capability units IIs-2, dryland and irrigated; pasture and hayland suitability group A-4; Clayey range site; and windbreak suitability group 4L.

Fm—Fillmore silt loam, 0 to 1 percent slopes. This deep, nearly level, poorly drained claypan soil is in shallow depressions in the uplands. It formed in loess. It is ponded for long periods. Areas range from 5 to about 200 acres in size. Most are oblong, irregularly shaped, or circular. Some form a ring around lower lying, wetter soils.

Typically, the surface layer is grayish brown, very friable silt loam about 7 inches thick. The subsurface layer is gray and light gray, very friable silt loam about 7 inches thick. The upper part of the subsoil is very dark gray and dark gray, very firm silty clay. The next part is dark grayish brown, very firm silt clay. The lower part to a depth of about 60 inches is light brownish gray, firm silty clay loam. In some areas the surface layer is less than 7 inches thick. In some cultivated areas it is gray because plowing has mixed it with the subsurface layer.

Included with this soil in mapping are small areas of Butler soils, the drained Fillmore soils, and Massie and Scott soils. Also included are small intermittent lakes. Butler soils do not have a distinct, gray subsurface layer in all areas. They are in slightly concave and plane areas and basins on the higher parts of the landscape and are somewhat poorly drained. The drained Fillmore soils are in areas where land leveling has filled in depressions or basins or where ditching has provided adequate drainage outlets. Massie and Scott soils have a surface soil that is thinner than that of the Fillmore soil. Scott soils and the intermittent lakes are in the deeper parts of depressions are more poorly drained than the Fillmore soil. Also, the intermittent lakes pond water for longer periods and are void of most vegetation. Included areas make up 15 percent or less of this unit.

Permeability is very slow in the claypan subsoil of the Fillmore soil. The water intake rate for irrigation is low. Available water capacity is high, but moisture is released slowly to plants. Runoff is ponded for long periods during the months March through July. A perched seasonal high water table is 0.5 foot above the surface to 1.0 foot below from March through August. Tilth is good. The shrink-swell is moderate in the surface layer and subsurface layer and high in the subsoil. Organic matter content is moderate, and natural fertility is medium.

About two-thirds of the acreage is farmed. The rest is areas of grasses used for grazing, hay, and wildlife habitat. Some of the farmed areas are irrigated, but most are used for dryland farming.

If used for dryland farming, this soil is poorly suited to grain sorghum, small grain, and alfalfa. Wheat and alfalfa are the least suitable crops because they are not so tolerant of the excess water as the other crops. Following heavy rains, runoff from the adjacent areas saturates the surface layer. Because no natural outlets are available, the water ponds for several days or weeks until it evaporates or is slowly absorbed by the soil. The excess water delays tillage and may drown crops. Harvest is often delayed. Terracing the higher lying adjacent areas slows the runoff rate on this soil. Puddling occurs if the soil is tilled when too wet. As it dries, the soil becomes hard and cannot be easily worked. Conservation tillage practices, such as till planting and disking, that leave crop residue on the surface help to prevent puddling, improve tilth, and conserve soil moisture. Returning crop residue and green manure crops to the soil and applying feedlot manure increase the organic matter content and help to prevent crusting. Also, they improve tilth, fertility, and water infiltration.

If irrigated by sprinklers, this soil is poorly suited to corn and grain sorghum because of the ponding. It is generally better suited to gravity irrigation. Sprinkler systems may cause additional ponding, and center-pivot sprinkler systems can stall during wet periods. Adjusting the application rate to the low water intake rate of the soil helps to prevent ponding.

This soil is suited to pasture and hay. Introduced grasses, generally reed canarygrass or a mixture of reed canarygrass and birdsfoot trefoil, are suitable. Overgrazing or grazing when the soil is ponded reduces the extent of the protective vegetation and causes compaction. Proper stocking rates and restricted use during wet periods help to keep the plants and the soil in good condition. Dug-out reservoirs for livestock and recreation are beneficial.

This soil is suited to range. The natural plant community is mostly mid and tall grasses dominated by big bluestem, indiangrass, little bluestem, and switchgrass. When the plants are overgrazed, the soil may be dominated by tall dropseed, Kentucky bluegrass, western wheatgrass, and numerous annual and perennial weeds. Also, woody plants, including snowberry and buckbrush, invade the site. Brush management and prescribed burning may be needed to control the woody plants. Grazing or haying when the soil is too wet causes surface compaction. A planned grazing system that includes proper grazing use and restricted use during wet periods maintains or improves the grasses and helps to keep the range in good condition. Dug-out reservoirs help to provide water for livestock and for recreation uses. The amount of refill depends on the amount of water that runs in from the higher lying adjacent areas.

This soil is fairly suited to the trees and shrubs grown as windbreaks. Only the species highly tolerant of the long periods of ponding are suited. Tillage and planting may not be possible in the spring until the water is absorbed and the soil begins to dry out. Young trees should be protected from grazing by livestock.

This soil is suited to habitat for wetland wildlife. It is fairly suited to habitat for openland and rangeland wildlife. The potential is fair for grain and seed crops and for wild herbaceous plants. It is good for grasses and legumes and for wetland plants, including sedges and perennial smartweed. Shrubs and conifers that are tolerant of shallow ponding can be planted. Except for willow, cottonwood, and similar species, hardwood trees grow only on the outer boundary of the soil. Waterfowl, such as geese and ducks, use the ponded areas in the spring and fall. Openland wildlife, such as pheasants, use areas of this soil for shelter and food during dry periods and during periods when ponded water is frozen in the winter. Hunting is the main recreational use, but it is limited because the potential for shallow water areas is only fair.

Because of the ponding and the very slow permeability, this soil is not suited to septic tank absorption fields. It is not suited to sewage lagoons or dwellings because of the ponding. A suitable alternative site for these uses is needed. Constructing local roads on suitable, well compacted fill material above the level of ponding, establishing adequate side ditches, and installing culverts help to prevent the road damage caused by ponding. The roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarse grained base material helps to ensure better performance. Installing a good surface drainage system and a gravel moisture barrier in the subgrade helps to prevent the damage by frost action. Crowning the road by grading and establishing adequate side ditches help to provide the needed surface drainage.

This soil is assigned to capability units IIIw-2, dryland and irrigated; pasture and hayland suitability group C-2; Clayey Overflow range site; and windbreak suitability group 2W.

Fo—Fillmore silt loam, drained, 0 to 1 percent slopes. This deep, nearly level, somewhat poorly drained claypan soil is in plane or slightly concave areas in the uplands. It formed in loess. It originally was a poorly drained soil in depressions or basins that were subject to ponding. Areas have been filled in, or ditches have been constructed to provide adequate outlets. The areas are no longer ponded. Most are somewhat oblong or irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is grayish brown, friable silt loam about 10 inches thick. The upper part of the subsurface layer is grayish brown, very friable silt loam about 6 inches thick. The lower part is light gray, very friable silt loam about 4 inches thick. The subsoil is about 26 inches thick. It is dark gray and dark grayish brown, very firm silty clay in the upper part and dark grayish brown, firm silty clay loam in the lower part. The underlying material to a depth of about 60 inches is grayish brown silty clay loam. In some areas the surface layer is less than 7 or more than 17 inches thick because of cutting and filling. In other areas it is less friable silty clay loam or silty clay.

Included with this soil in mapping are small areas of Crete, Butler, and undrained Fillmore soils. Crete soils are moderately well drained and are slightly higher on the landscape than this Fillmore soil. Butler soils are in landscape positions similar to those of this Fillmore soil. The undrained Fillmore soils are in depressional areas that have not been leveled or ditched. Included soils make up as much as 15 percent of this unit.

Permeability is very slow in the claypan subsoil of this Fillmore soil. The water intake rate for irrigation is low. Available water capacity is high, but moisture is released slowly to plants. Runoff is slow. After heavy rains, the surface soil is saturated for long periods. The perched seasonal high water table is 1 to 3 feet below the surface, mainly from April through July. Tilth is good where the surface layer is silt loam, fair where it is silty clay loam, and poor where it is silty clay. The shrink-swell potential is moderate in the surface layer and subsurface layer and high in the subsoil. Organic matter content is moderate, and natural fertility is medium.

Nearly all of the acreage is irrigated and farmed.

If used for dryland farming, this soil is suited to small grain, grain sorghum, and grasses and legumes. Grain sorghum and wheat are better able to withstand the slow release of moisture from the subsoil. Small grain, such as wheat, matures before the weather becomes hot and dry. Because the surface layer is often saturated in the spring, tillage is delayed. Puddling and compaction occur if this soil is tilled when wet, especially in areas where the fill material is clayey. As the soil dries, it becomes hard and cannot be easily worked. Delaying tillage until the soil moisture content is low prevents compaction and puddling. Returning crop residue to the soil helps to maintain the organic matter content and fertility level, helps to prevent crusting and compaction, and improves tilth and water infiltration. Including a deep-rooted legume, such as alfalfa, in the cropping sequence loosens compacted layers and the claypan subsoil, thereby improving water infiltration and fertility and tilth. Crop rotation interrupts weed, insect, and disease cycles. Leaving crop stubble standing throughout winter helps to trap snow, thus providing additional soil moisture.

If irrigated by a gravity or sprinkler system, this soil is suited to corn, grain sorghum, soybeans, and grasses and legumes. Tillage and seedling establishment are difficult in areas where the fill material is clayey. Adding zinc and organic matter improves fertility and tilth in

these areas. Sprinkler irrigation helps to soften a crusted surface and thus facilitates the emergence of seedlings. Using an application rate suited to the low water intake rate of this soil reduces the runoff rate. If a gravity system is used, a tailwater recovery system conserves irrigation water and improves the efficiency of water application.

This soil is suited to the trees grown as windbreaks. Occasional wetness sometimes delays planting in wet years. Tilling and planting when the soil is dry enough helps to prevent puddling and compaction. Because of the high shrink-swell potential, cracks form in the soil during dry periods, allowing air to dry out the roots of seedlings. Light cultivation helps to prevent the formation of surface cracks, but supplemental water is needed to keep the subsoil from cracking or to close existing cracks.

Septic tank absorption fields do not function well in this soil because of the wetness and the very slow permeability. Fill material is needed to raise the field a sufficient distance above the perched seasonal high water table. Enlarging the field helps to overcome the very slow permeability. Otherwise, an alternative system can be installed. Using fill material on sites for sewage lagoons, dwellings, and local roads helps to avoid the effects of the seasonal high water table on those uses. Providing side ditches and culverts also helps to protect roads from wetness. Strengthening the foundations of buildings and backfilling with coarse material help to prevent the structural damage caused by shrinking and swelling. Roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing a coarser grained base material helps to ensure better performance. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

This soil is assigned to capability units IIw-2, dryland and irrigated; pasture and hayland suitability group A-4; Clayey range site; and windbreak suitability group 2W.

GeC2—Geary silty clay loam, 3 to 6 percent slopes, eroded. This deep, gently sloping, well drained soil is on the lower side slopes of upland breaks to stream terraces and upland drainageways. Rills and small gullies are common. The soil formed in loess. Areas are irregular in shape and range from 5 to 80 acres in size.

Typically, the surface layer is brown, friable silty clay loam about 6 inches thick. In most areas erosion has removed some or all of the original surface layer of dark silt loam, and in places it has removed part of the subsoil. The part of the original surface layer that has not been removed has been mixed by tillage with the upper part of the subsoil. The subsoil is firm silty clay loam about 35 inches thick. The upper part is brown, and the lower part is strong brown. The underlying material to a depth of about 60 inches is reddish yellow and light brown, calcareous silty clay loam. In a few areas of native grassland, the surface layer is silt loam. In some places the subsoil is sandy clay loam. In other places the content of clay is more than 35 percent in the subsoil. In a few areas lime is within a depth of 36 inches or is at the surface.

Included with this soil in mapping are small areas of eroded Crete soils, eroded Hastings and Hobbs soils, and outcrops of sand. Crete and Hastings soils are on the upper parts of side slopes. They have more clay in the subsoil than this Geary soil. Hobbs soil are stratified and are on the narrow bottoms of drainageways. The sand outcrops are on the lower side slopes. Included soils make up as much as 15 percent of this unit.

Permeability is moderately slow in this Geary soil. Available water capacity is high, and the water intake rate for irrigation is low. Runoff is medium. The surface layer is medium acid to mildly alkaline, depending on the extent of erosion. Natural fertility is medium, and organic matter content is low. The available phosphorus level is low. Because of the low organic matter content and the silty clay loam surface layer, this soil is difficult to till. The shrink-swell potential is moderate.

Nearly all the acreage is used for dryland farming. A few areas are irrigated. Some areas have been reseeded to introduced or native grasses and are used for pasture or range.

If used for dryland farming, this soil is suited to small grain, grain sorghum, and grasses and legumes. The main hazard is water erosion. Terraces, contour farming, and grassed waterways help to control the runoff that causes the formation of rills and small gullies. Conservation tillage practices, such as stubble mulching and till planting, that leave crop residue on the surface help to control water erosion and conserve soil moisture. Leaving crop stubble standing throughout winter traps blowing snow, thus providing additional soil moisture. This soil puddles after hard rains or if worked when it is too wet. As the soil dries, it becomes hard. A cropping system dominated by close-growing crops, such as wheat, alfalfa, or grasses, improves tilth and water infiltration and helps to control erosion. Returning crop residue and green manure crops to the soil and applying feedlot manure improve fertility, increase the organic matter content, and improve tilth and water infiltration. Phosphorus fertilizer is needed if alfalfa is grown.

If irrigated, this soil is suited to grasses and alfalfa. If erosion is controlled, the soil is suited to irrigated corn, grain sorghum, and soybeans. The sprinkler system is the best method of irrigating this soil, but the adjacent steep slopes commonly limit its use. Contour bench leveling can control runoff in some of the less sloping areas. Because of the slope, controlling runoff and the erosion caused by rainfall and irrigation water is difficult. If a sprinkler system is used, terraces are effective in controlling water erosion. Using a water application rate

suited to the low intake rate of this soil helps to control runoff. Conservation tillage practices, such as till planting and disking, that leave crop residue on the surface help to control water erosion, conserve moisture, and improve tilth.

This soil is suited to pasture and hay, which can be rotated with other crops. A cover of introduced grasses, generally bromegrass or orchardgrass or a mixture of one of those with alfalfa, reduces the hazard of water erosion. Overgrazing reduces the extent of the protective plant cover, lowers the quality of the plants, and increases the hazards of runoff and erosion. Proper stocking rates, rotation grazing, and timely applications of nitrogen and phosphorus fertilizer keep the pasture and the soil in good condition.

This soil is suited to range. A cover of range plants is very effective in controlling water erosion. The native plant community is mostly mid and tall grasses dominated by big bluestem, indiangrass, little bluestem, porcupinegrass, sideoats grama, and switchgrass. When the plants are overgrazed or improperly harvested for hay, big bluestem, little bluestem, indiangrass, and switchgrass decrease in abundance and sideoats grama, tall dropseed, Kentucky bluegrass, and annual and perennial weeds increase. If overgrazing continues for many years, the abundance of the less desirable plants, especially Kentucky bluegrass, buckbrush, snowberry, and sumac, increases. Deferred grazing helps to maintain or improve the range.

This soil is suited to the moderately drought tolerant trees grown as windbreaks. If competing vegetation is removed by good site preparation and timely control measures, the seedlings generally survive. Planting the rows of trees on the contour and planting a cover crop between the rows reduce the water erosion hazard. Some seedlings require supplemental water during dry periods.

The moderately slow permeability is a limitation if this soil is used as a site for septic tank absorption fields. This limitation generally can be overcome, however, by increasing the size of the absorption field. On sites for sewage lagoons, extensive grading is needed to modify the slope and shape the lagoon. Lining and sealing the lagoon helps to prevent seepage. Strengthening the foundations of dwellings and backfilling with coarse material help to prevent the structural damage caused by shrinking and swelling. Roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to ensure better performance.

This soil is assigned to capability units IIIe-8, dryland, and IIIe-3, irrigated; pasture and hayland suitability group A-2; Silty range site; and windbreak suitability group 3.

GeD2—Geary silty clay loam, 6 to 11 percent slopes, eroded. This deep, strongly sloping, well drained soil is on the lower side slopes of upland breaks to stream terraces and drainageways. Small gullies are common. The soil formed in reddish loess. Areas range from 5 to 100 acres in size and are irregular in shape.

Typically, the surface layer is brown, firm silty clay loam about 6 inches thick. In most areas erosion has removed the original surface layer of dark silt loam, and in places it has removed part of the subsoil. The part of the original surface layer that has not been removed has been mixed with the subsoil by tillage. The subsoil is firm silty clay loam about 24 inches thick. The upper part is brown, and the lower part is reddish yellow. The underlying material to a depth of about 60 inches is light brown, calcareous silty clay loam. In a few areas of native grassland, the surface layer is silt loam. In some places the subsoil is sandy clay loam. In other places the content of clay is more than 35 percent in the subsoil. In many places erosion has exposed the underlying material. In a few areas lime is within a depth of 36 inches, and in some areas it is at the surface.

Included with this soil in mapping are small areas of eroded Hastings and Hobbs soils, eroded Holder and Kezan soils, and outcrops of sand and gravel. Hastings soils have more clay in the subsoil than this Geary soil. Hastings and Holder soils do not have reddish layers. They are on the upper parts of side slopes. Hobbs and Kezan soils are stratified and are at the bottoms of drainageways. The outcrops of sand and gravel are in the lower areas. Included soils make up as much as 15 percent of this unit.

Permeability is moderately slow in this Geary soil. Available water capacity is high, and the water intake rate for irrigation is low. Runoff is medium or rapid. The surface layer is slightly acid to mildly alkaline, depending on the extent of erosion. Natural fertility is medium, and organic matter content is low because of the loss of the original surface layer through erosion. The amount of available phosphates is deficient. The shrink-swell potential is moderate.

Most of the acreage is used for dryland farming. A few areas are irrigated. Some areas have been reseeded to introduced or native grasses and are used for pasture or range.

If used for dryland farming, this soil is poorly suited to corn and grain sorghum. It is better suited to small grain and legumes and grasses than to row crops. Sheet and gully erosion are difficult to control in cultivated areas, and including corn and grain sorghum in the cropping sequence increases the susceptibility to erosion. Terraces, contour farming, and grassed waterways reduce the hazards of runoff and water erosion. Conservation tillage practices, such as stubble mulching and till planting, that leave crop residue on the surface help to control water erosion and conserve soil moisture. Leaving crop stubble standing throughout winter helps to control soil blowing. Also, the stubble traps blowing snow, thus providing additional soil moisture. This soil

puddles after hard rains or if it is worked when too wet. As the soil dries, it becomes hard. Returning crop residue and green manure crops to the soil and applying feedlot manure increase the organic matter content and improve tilth, water infiltration, and fertility. Phosphorus fertilizer is needed if alfalfa is grown.

If irrigated, this soil is suited to close-grown crops, such as small grain and legumes and grasses. Growing row crops increases the hazard of erosion. Terraces are effective in controlling runoff and water erosion in areas irrigated by sprinkler systems, but the steep adjacent slopes commonly limit the use of sprinkler systems and make gravity systems unsuited. Using a water application rate suited to the low intake rate of this soil helps to control runoff. Leaving crop residue on the surface conserves soil moisture, improves tilth, and increases the water intake rate.

This soil is suited to pasture and hay, which can be rotated with other crops. A cover of introduced grasses, generally bromegrass or orchardgrass or a mixture of one of those with alfalfa, reduces the hazard of water erosion. Overgrazing reduces the extent of the protective plant cover, lowers the quality of the plants, and increases the hazards of runoff and erosion. Proper stocking rates, rotation grazing, and timely applications of nitrogen and phosphorus fertilizer keep the plants and the soil in good condition.

This soil is suited to range. A cover of range plants is effective in controlling water erosion. The native plant community is mostly mid and tall grasses dominated by big bluestem, indiangrass, little bluestem, porcupinegrass, sideoats grama, and switchgrass. When the plants are overgrazed or improperly harvested for hay, big bluestem, little bluestem, indiangrass, and switchgrass decrease in abundance and sideoats grama, tall dropseed, Kentucky bluegrass, and annual and perennial weeds increase. If overgrazing continues for many years, the abundance of the less desirable plants, especially Kentucky bluegrass, buckbrush, snowberry, and sumac, increases. Deferred grazing helps to keep the range in good condition. Constructing earth dams in drainageways helps to intercept runoff for livestock water.

This soil is suited to the moderately drought tolerant trees grown as windbreaks. If competing vegetation is removed by good site preparation and timely control measures, the seedlings generally survive, but the growth rate is slower than that on some less sloping soils. Planting the rows of trees on the contour, terracing, and planting a cover crop between the rows reduce the water erosion hazard. Some seedlings require supplemental water during dry periods.

The slope and the moderately slow permeability are limitations if this soil is used as a site for septic tank absorption fields. The moderately slow permeability generally can be overcome by increasing the size of the absorption field. Land shaping and installing the absorption field on the contour help to ensure proper performance. On sites for sewage lagoons, extensive grading is needed to modify the slope and shape the lagoon. Lining or sealing the lagoon helps to prevent seepage. Dwellings should be designed so that they conform to the natural slope of the land, or the site should be graded. Strengthening the foundations and backfilling with coarse material help to prevent the structural damage caused by shrinking and swelling. Cuts and fills generally are needed to provide a suitable grade for local roads. The roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to ensure better performance.

This soil is assigned to capability units IVe-8, dryland, and IVe-3, irrigated; pasture and hayland suitability group A-2; Silty range site; and windbreak suitability group 3.

GeE2—Geary silty clay loam, 11 to 17 percent slopes, eroded. This deep, moderately steep, somewhat excessively drained soil is on the short sides of upland drainageways. Rills and gullies are common. The soil formed in reddish brown loess. Areas range from 5 to about 60 acres in size.

Typically, the surface layer is brown, firm silty clay loam about 5 inches thick. In most areas erosion has removed some or all of the original surface layer of dark silt loam and most of the subsoil. The subsoil is firm silty clay loam about 20 inches thick. It is brown in the upper part and reddish yellow in the lower part. The underlying material to a depth of about 60 inches is pink, calcareous silty clay loam. In many places erosion has exposed the underlying material. In some areas lime is within a depth of 36 inches, and in other areas it is at the surface.

Included with this soil in mapping are small areas of eroded Uly soils, eroded Hastings soils, and Hobbs soils. Uly soils are on the short, moderately steep and steep sides of drainageways at a higher position on the landscape than that of this Geary soil. Also, they have less clay in the subsoil and do not have reddish brown layers. Hastings soils are less sloping than this Geary soil and have more clay in the subsoil. Hobbs soils are stratified and are on the narrow bottoms of drainageways. Included soils make up as much as 15 percent of this unit.

Permeability is moderately slow in this Geary soil, and available water capacity is high. Runoff is rapid. Tilth is poor. Organic matter content is low, and natural fertility is medium. The shrink-swell potential is moderate.

Nearly all the acreage is farmed. A few areas have been reseeded to introduced or native grasses used for grazing or hay.

This soil is generally unsuited to dryland and irrigated farming because of the moderately steep slopes and the

water erosion hazard. Reseeding cultivated areas to grass helps to control erosion.

This soil is suited to pasture and hay, which can be rotated with other crops. A cover of introduced grasses, generally bromegrass or orchardgrass or a mixture of one of those with alfalfa, reduces the hazard of water erosion. Overgrazing reduces the extent of the protective plant cover, lowers the quality of the plants, and increases the hazards of runoff and erosion. Proper stocking rates, rotation grazing, and timely applications of nitrogen and phosphorus fertilizer keep the plants and the soil in good condition.

This soil is suited to range. A cover of range plants is very effective in controlling water erosion. The native plant community is mostly mid and tall grasses dominated by big bluestem, indiangrass, little bluestem, porcupinegrass, sideoats grama, and switchgrass. When the plants are overgrazed or improperly harvested for hay, big bluestem, little bluestem, indiangrass, and switchgrass decrease in abundance and sideoats grama, tall dropseed, Kentucky bluegrass, and annual and perennial weeds increase. If overgrazing continues for many years, the abundance of the less desirable plants, especially Kentucky bluegrass, buckbrush, snowberry, and sumac, increases. The correct placement of fences and watering and salting facilities can ensure the proper distribution of livestock. Constructing earth dams and excavated ponds helps to provide water for livestock, irrigation, and recreation uses and helps to control runoff. Applying conservation land treatment measures near those structures helps to prevent sedimentation.

This soil is suited to the moderately drought tolerant trees grown as windbreaks. If competing vegetation is removed by good site preparation and timely control measures, the seedlings generally survive, but the growth rate is slower than that on some less sloping soils. Planting the rows of trees on the contour, terracing, and planting a cover crop between the rows reduce the water erosion hazard. Some seedlings require supplemental water during dry periods.

The slope and the moderately slow permeability are limitations if this soil is used as a site for septic tank absorption fields. The moderately slow permeability generally can be overcome by increasing the size of the absorption field. Land shaping and installing the absorption field on the contour help to ensure proper performance. On sites for sewage lagoons, some grading is needed to modify the slope and shape the lagoon. Lining or sealing the lagoon helps to prevent seepage. Dwellings should be designed so that they conform to the natural slope of the land, or the site should be graded. Strengthening the foundations and backfilling with coarse material help to prevent the structural damage caused by shrinking and swelling. Cuts and fills generally are needed to provide a suitable grade for local roads. The roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to ensure better performance.

This soil is assigned to capability unit VIe-8, dryland; pasture and hayland suitability group A-3; Silty range site; and windbreak suitability group 3.

GhF—Geary-Hobbs silt loams, 0 to 30 percent slopes. This map unit consists of a deep, somewhat excessively drained, moderately steep and steep Geary soil on uplands and a deep, nearly level, well drained Hobbs soil on bottom lands. The Geary soil is on the sides of upland drainageways. It formed in loess. The Hobbs soil is at the bottom of narrow, channeled drainageways. It formed in stratified, silty alluvium and is occasionally flooded. Areas are 50 to 70 percent Geary soil and 30 to 50 percent Hobbs soil. The areas of the two soils are so long and narrow that it was not practical to map them separately.

Typically, the Geary soil has a surface layer of grayish brown, very friable silt loam about 6 inches thick. The subsoil is silty clay loam about 30 inches thick. The upper part is brown and friable, the next part is brown and light brown and is firm, and the lower part is light brown and friable. The underlying material to a depth of about 60 inches is pink, calcareous silty clay loam. The subsoil is exposed in small eroded areas that have been overgrazed or cultivated and on eroded catsteps.

Typically, the Hobbs soil has a surface layer of stratified dark grayish brown and brown, friable silt loam about 8 inches thick. The underlying material is about 42 inches thick. It is stratified grayish brown, gray, and pale brown. The upper part is silt loam, and the lower part is silty clay loam. Between depths of 50 and 60 inches is a buried surface layer that is stratified dark grayish brown and grayish brown silty clay loam. In some areas the surface layer is silty clay loam or fine sandy loam.

Included with these soils in mapping are small areas of Muir, Kezan, and Uly soils and outcrops of sand and gravel. Uly soils have less clay in the subsoil than the Geary soil. They are on the short, steep sides of drainageways and generally are higher on the landscape than the Geary soil. Kezan soils are poorly drained and are on the narrow bottoms of drainageways. Muir soils have less clay in the subsoil than the Geary soil. They are on foot slopes. The sand and gravel outcrops are in the lower areas of the Geary soil. Included soils make up as much as 20 percent of this unit.

Permeability is moderately slow in the Geary soil and moderate in the Hobbs soil. Available water capacity is high in both soils, and moisture is released readily to plants. Runoff is rapid on the Geary soil and slow on the Hobbs soil. Tilth is good in both soils, organic matter content is moderate, and natural fertility is high. The shrink-swell potential is moderate in the Geary soil and low in the Hobbs soil.

Nearly all of the acreage is grassland used for grazing or hay. A few areas are farmed or pastured.

These soils are generally unsuited to dryland and irrigated farming because of the slope and a very severe erosion hazard. Reseeding the cultivated areas to grass helps to control erosion.

A few of the less sloping areas of the Geary soil and most areas of the Hobbs soil are suited to pasture and hay, which can be rotated with other crops. A cover of introduced grasses, generally bromegrass or orchardgrass or a mixture of one of those with alfalfa, is effective in controlling water erosion. Overgrazing reduces the extent of the protective plant cover, lowers the quality of the plants, and increases the runoff rate and the susceptibility to erosion. Proper stocking rates, rotation grazing, and timely applications of nitrogen fertilizer keep the plants and the soil in good condition.

These soils are suited to range. A cover of range plants is very effective in controlling water erosion. The native plant community is mostly mid and tall grasses. The Geary soil is dominated by big bluestem, indiangrass, little bluestem, porcupinegrass, sideoats grama, and switchgrass. The Hobbs soil is dominated by big bluestem, little bluestem, switchgrass, and various sedges. When the plants are overgrazed or improperly harvested for hay, big bluestem, little bluestem, indiangrass, and switchgrass decrease in abundance and sideoats grama, tall dropseed, Kentucky bluegrass, and annual and perennial weeds increase. If overgrazing continues for many years, the abundance of the less desirable plants, especially Kentucky bluegrass, buckbrush, snowberry, sumac, and sedges, increases.

The correct placement of fences and watering and salting facilities can ensure the proper distribution of livestock. Reseeding or interseeding is needed in some areas where the native plant community has deteriorated. Occasional flooding on the Hobbs soil in the areas of narrow bottom land can cause sedimentation and can introduce weeds. Controlling weeds and brush allows reestablishment of the desirable grasses. Constructing earth dams and excavated ponds helps to provide water for livestock, irrigation, and recreation uses and helps to control runoff. Applying conservation land treatment measures near those structures helps to prevent sedimentation.

The Geary soil generally is poorly suited to the trees grown as windbreaks, but some types of special site preparation can improve the suitability for trees and shrubs. The Hobbs soil is suited to windbreaks. Occasionally, flooding damages some new plantings. Once the trees are established, however, the additional moisture is beneficial. Competing grasses, weeds, and shrubs should be controlled. Young trees should be protected from grazing by livestock.

These soils generally are not suitable as sites for dwellings because of the slope of the Geary soil and the flooding on the Hobbs soil. A suitable alternative site is needed. Cuts and fills generally are needed to provide a suitable grade for local roads. The roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soils. Providing coarser grained base material helps to ensure better performance. Constructing the roads on suitable, well compacted fill material above flood levels and providing adequate side ditches and culverts help to prevent flood damage in areas of the Hobbs soil.

These soils are assigned to capability unit VIe-1, dryland; pasture and hayland suitability groups H-1 and A-1; Silty and Silty Overflow range sites; and windbreak suitability groups 10 and 1.

Hc—Hastings silt loam, 0 to 1 percent slopes. This deep, nearly level, well drained soil is in plane and slightly convex areas on uplands. It formed in loess. Areas are mostly broad and irregular in shape and range from 5 to more than 2,000 acres in size.

Typically, the surface layer is grayish brown, friable silt loam about 7 inches thick. The subsurface layer is dark grayish brown, very friable silt loam about 4 inches thick. The subsoil is silty clay loam about 31 inches thick. It is dark grayish brown and friable in the upper part, brown and pale brown and firm in the next part, and pale brown and friable in the lower part. The underlying material to a depth of about 60 inches is very pale brown silt loam. It is calcareous in the lower part. In some areas the surface layer is less than 5 inches thick because of cuts made during land leveling. In these areas tillage has mixed some of the surface layer with the upper part of the subsoil. In places the soil is dark to a depth of more than 20 inches.

Included with this soil in mapping are small areas of Crete, Butler, and Fillmore soils and areas where a lighter colored subsoil or underlying material is exposed because of land leveling. These included areas make up 15 percent or less of the unit. Crete and Butler soils are slightly lower on the landscape than the Hastings soil and are more poorly drained. In most areas of Fillmore soils, the surface has been covered with fill material and surface drainage has been improved. Butler, Crete, and Fillmore soils have more clay in the subsoil than the Hastings soil. Butler and Fillmore soils have dark gray layers in the subsoil. Fillmore soils have a distinct, grayish subsurface layer.

Permeability is moderately slow in the Hastings soil. Available water capacity is high, and moisture is released readily to plants. The water intake rate for irrigation is moderately low. Runoff is slow. Tilth is good in areas where the surface layer is moderate in organic matter content and high in natural fertility. Organic matter content is low, tilth is poor, and the amount of available zinc is deficient, however, in areas where deep cuts have been made during land leveling. The shrink-swell

potential is moderate in the surface layer and high in the subsoil.

Most of the acreage is farmed. Most areas are irrigated, but a few are used for dryland farming. A few areas of grasses are used for grazing or hay.

If used for dryland farming, this soil is suited to small grain, grain sorghum, corn, and grasses and legumes. Conservation of soil moisture is a concern if the soil is cultivated. Conservation tillage practices, such as till planting, chiseling, and disking, leave crop residue on the surface and thus conserve soil moisture. Summer fallowing also conserves moisture. Leaving crop stubble standing throughout the winter helps to control soil blowing. Also, the stubble traps snow and thus adds soil moisture. Returning crop residue and green manure crops to the soil and applying feedlot manure increase the organic matter content and improve fertility, tilth, and water infiltration. Rotation of crops improves tilth and water infiltration and interrupts weed, insect, and disease cycles. Including nitrogen-fixing crops, such as alfalfa, in the cropping sequence improves fertility.

If irrigated, this soil is suited to corn, grain sorghum, soybeans, and grasses and legumes. It is suited to both gravity and sprinkler systems. Land leveling improves surface drainage and results in a more uniform distribution of water in areas irrigated by a gravity system. If the leveling exposes the subsoil, additions of organic matter and zinc are needed to improve tilth and fertility. Adjusting the application rate to the moderately low water intake rate of the soil conserves irrigation water. If a gravity irrigation system is used, a tailwater recovery system is needed to conserve irrigation water and improve the efficiency of water application. Conservation tillage practices, such as chiseling and disking, leave crop residue on the surface and thus conserve moisture.

This soil is suited to pasture and hay, which can be rotated with other crops. A cover of introduced grasses, generally bromegrass or orchardgrass or a mixture of one of those with alfalfa, is effective in controlling water erosion. Overgrazing reduces the extent of the protective plant cover, lowers the quality of the plants, and increases the runoff rate and soil losses. Proper stocking rates, rotation grazing, and timely applications of nitrogen fertilizer keep the plants and the soil in good condition.

This soil is suited to range. A cover of range plants is very effective in improving the water intake rate and tilth. The natural plant community is mostly mid and tall grasses dominated by big bluestem, indiangrass, little bluestem, porcupinegrass, sideoats grama, and switchgrass. When the plants are overgrazed or improperly harvested for hay, big bluestem, little bluestem, indiangrass, and switchgrass decrease in abundance and sideoats grama, tall dropseed, Kentucky bluegrass, and annual and perennial weeds increase. If overgrazing continues for many years, the less desirable plants, especially Kentucky bluegrass, buckbrush, snowberry, and sumac, increase in abundance. Deferred grazing helps to maintain or improve the native grasses.

This soil is suited to the moderately drought resistant trees grown as windbreaks. If competing vegetation is removed by good site preparation and by timely control measures, the seedlings generally survive. They may require supplemental water during dry periods.

The moderately slow permeability is a limitation if this soil is used as a site for septic tank absorption fields. It generally can be overcome, however, by increasing the size of the absorption field. Lining and sealing sewage lagoons helps to prevent seepage. Strengthening the foundations of dwellings and backfilling with coarse material help to prevent the structural damage caused by shrinking and swelling. Local roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to ensure better performance. Mixing the base material with additives, such as hydrated lime, helps to prevent shrinking and swelling.

This soil is assigned to capability units I-1, dryland, and I-4, irrigated; pasture and hayland suitability group A-2; Silty range site; and windbreak suitability group 3.

HcB—Hastings silt loam, 1 to 3 percent slopes. This deep, very gently sloping, well drained soil is mostly on the ridges of divides. In some areas it is on the sides of upland drainageways. The soil formed in loess. Areas are somewhat oblong or irregular in shape and range from 5 to more than 1,000 acres in size.

Typically, the surface layer is grayish brown, very friable silt loam about 7 inches thick. The subsoil is silty clay loam about 28 inches thick. It is dark grayish brown and friable in the upper part, brown and firm in the next part, and pale brown and friable in the lower part. The underlying material to a depth of about 60 inches is pale brown silt loam. It is calcareous in the lower part. In some cultivated areas the surface layer is less than 5 inches thick and has been mixed by tillage with the upper part of the subsoil.

Included with this soil in mapping are small areas of Crete and Fillmore soils and severely eroded soils. Crete soils have more clay in the subsoil than this Hastings soil. They are in positions on the landscape similar to those of this Hastings soil and are moderately well drained. Fillmore soils are poorly drained, are in depressions, and have a distinct, grayish subsurface layer. The severely eroded soils are lighter in color than this Hastings soil because the subsoil or underlying material is exposed. Included soils make up as much as 15 percent of this unit.

Permeability is moderately slow in this Hastings soil. Available water capacity is high. Moisture is released readily to plants, and the water intake rate for irrigation is moderately low. Runoff is medium. Generally, the surface layer is moderate in organic matter content and high in

natural fertility, and tilth is good. In severely eroded areas, however, organic matter content is low, tilth is poor, and the amount of available phosphates is deficient. The shrink-swell potential is moderate in the surface layer and high in the subsoil.

Most of the acreage is farmed. Most of the farmed areas are irrigated, but some are used for dryland farming. A few areas of grassland are used for grazing or hay.

If used for dryland farming, this soil is suited to small grain, grain sorghum, soybeans, corn, and grasses and legumes. Water erosion is a hazard. It can be controlled by terraces, contour farming, and grassed waterways. Conservation tillage practices, such as till planting, chiseling, and disking, that leave crop residue on the surface help to control water erosion and soil blowing and conserve soil moisture. Leaving crop stubble standing throughout winter helps to control soil blowing. Also, the stubble traps blowing snow, thus providing additional soil moisture. Returning crop residue and green manure crops to the soil and applying feedlot manure increase the organic matter content and improve fertility, tilth, and water infiltration. Those practices and additional amounts of phosphate fertilizer are especially needed in the severely eroded areas. Including nitrogen-fixing crops, such as alfalfa, in the cropping sequence improves fertility.

If irrigated, this soil is suited to corn, grain sorghum, soybeans, and grasses and legumes (fig. 9). A gravity or sprinkler system of irrigation can be used on this soil. If a gravity system is used, contour bench leveling is needed to control water erosion and a tailwater recovery system is needed to conserve runoff from irrigation and improve the efficiency of water application. Applying water at a rate suited to the moderately low water intake rate of this soil helps to control runoff of irrigation water. Conservation tillage practices, such as chiseling and disking, that leave crop residue on the surface help to control water erosion and conserve moisture. In the areas of severely eroded soils, additions of organic matter and phosphates are needed to improve tilth and fertility.

This soil is suited to pasture and hay, which can be rotated with other crops. A cover of introduced grasses, generally bromegrass or orchardgrass or a mixture of one of those with alfalfa, is effective in controlling water erosion. Overgrazing reduces the extent of the protective plant cover, lowers the quality of the plants, and increases the hazards of runoff and erosion. Proper stocking rates, rotation grazing, and timely applications of nitrogen fertilizer keep the plants and the soil in good condition.

This soil is suited to range. A cover of range plants is very effective in controlling water erosion. The native plant community is mostly mid and tall grasses dominated by big bluestem, indiangrass, little bluestem, porcupinegrass, sideoats grama, and switchgrass. When the plants are overgrazed or improperly harvested for hay, big bluestem, little bluestem, indiangrass, and switchgrass decrease in abundance and sideoats grama, tall dropseed, Kentucky bluegrass, and annual and perennial weeds increase. If overgrazing continues for many years, the abundance of the less desirable plants, especially Kentucky bluegrass, buckbrush, snowberry, and sumac, increases. Deferred grazing helps to maintain or improve the extent and quality of native grasses.

This soil is suited to the moderately drought resistant trees grown as windbreaks. Where feasible, planting trees on the contour helps to prevent water erosion. If competing vegetation is removed by good site preparation and timely control measures, the seedlings generally survive. Some seedlings require supplemental water during dry periods.

The moderately slow permeability of this soil is a limitation on sites for septic tank absorption fields, but this limitation generally can be overcome by increasing the size of the absorption area. On sites for sewage lagoons, some grading is needed to modify the slope and shape the lagoon. Lining or sealing the lagoon helps to prevent seepage. Strengthening the foundations of dwellings and backfilling with coarse material help to prevent the structural damage caused by shrinking and swelling. Local roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to ensure better performance. Mixing the base material with additives, such as hydrated lime, helps to prevent shrinking and swelling.

This soil is assigned to capability units IIe-1, dryland, and IIe-4, irrigated; pasture and hayland suitability group A-2; Silty range site; and windbreak suitability group 3.

HcC—Hastings silt loam, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is mostly on narrow, convex divides between steep upland drainageways and on the side slopes of upland breaks to stream terraces. In some areas it is on broad divides and on the sides of upland drainageways. The soil formed in loess. Areas are somewhat oblong or irregular in shape and range from 5 to about 100 acres in size.

Typically, the surface layer is dark gray, very friable silt loam about 7 inches thick. The subsoil is silty clay loam about 28 inches thick. It is dark grayish brown and very friable in the upper part, brown and light yellowish brown and firm in the next part, and light yellowish brown and friable in the lower part. The underlying material to a depth of about 60 inches is pale yellow silt loam. It is calcareous in the lower part. In some cultivated areas the surface layer is less than 5 inches thick or has been mixed by tillage with the upper part of the subsoil. In places the content of clay is less than 35 percent in the subsoil.

Figure 9.—Center-pivot irrigation in an area of Hastings silt loam, 1 to 3 percent slopes, used for soybeans.

Included with this soil in mapping are small areas of Crete, Geary, Hobbs, and Muir soils and severely eroded soils in which the subsoil or underlying material is exposed. Crete soils are not so well drained as this Hastings soil and have more clay in the subsoil. They are in positions on the landscape similar to those of this Hastings soil. Geary soils have reddish layers and are lower on side slopes than this Hastings soil. Hobbs soils are stratified and are at the bottoms of drainageways. Muir soils have less clay in the subsoil than this Hastings soil and are on foot slopes. Included soils make up as much as 10 percent of this unit.

Permeability is moderately slow in this Hastings soil. Available water capacity is high. Moisture is released readily to plants, and the water intake rate for irrigation is moderately low. Runoff is medium. Generally, the surface layer is moderate in organic matter content and high in natural fertility, and tilth is good. In the eroded areas, however, tilth is poor, organic matter content is low, and the amount of available phosphates is deficient. The shrink-swell potential is moderate in the surface layer and high in the subsoil.

Most of the acreage is grassland used for grazing or hay. The rest is used mainly for dryland farming. A few areas are irrigated.

If used for dryland farming, this soil is suited to small grain, grain sorghum, and grasses and legumes. Water erosion is the main hazard. Water erosion and runoff can be controlled by terraces, contour farming, and grassed waterways. Conservation tillage practices that leave crop residue on the surface help to control water erosion and conserve moisture. Leaving crop stubble standing throughout winter helps to control soil blowing. Also, the stubble traps blowing snow, thus providing additional soil moisture. A cropping system that includes close-growing crops, such as wheat, alfalfa, or grasses, helps to control erosion and improves tilth and water infiltration. Returning crop residue and green manure crops to the

soil and applying feedlot manure increase the organic matter content and improve fertility, tilth, and water infiltration. Additional phosphates are needed in the areas of eroded soils.

If irrigated, this soil is suited to grasses and to legumes, such as alfalfa. If erosion is controlled, the soil is suited to irrigated corn, grain sorghum, and soybeans. The sprinkler system is the best method of irrigation, but the steep adjacent slopes commonly limit its use. Contour bench leveling is suited to some of the less sloping areas irrigated by a gravity system. The slopes hinder the control of runoff and of the erosion caused by rainfall and irrigation. If a center-pivot system is used, grass-covered terraces help to intercept runoff and prevent excessive water erosion, especially in wheel tracks. The grass on the terraces keeps the wheels from making deep furrows in the soil. Additional crop residue is available because of irrigation. Leaving the residue on the surface by applying conservation tillage practices, such as till planting, helps to control water erosion. The rate of water application should be suited to the moderately low intake rate of this soil.

This soil is suited to pasture and hay, which can be rotated with other crops. A cover of introduced grasses, generally bromegrass or orchardgrass or a mixture of one of those with alfalfa, is effective in controlling water erosion. Overgrazing reduces the extent of the protective plant cover, lowers the quality of the plants, and increases the hazards of runoff and erosion. Proper stocking rates, rotation grazing, and timely applications of nitrogen fertilizer keep the plants and the soil in good condition.

This soil is suited to range. A cover of range plants is very effective in controlling water erosion. The native plant community is mostly mid and tall grasses dominated by big bluestem, porcupinegrass, little bluestem, indiangrass, sideoats grama, and switchgrass. When the plants are overgrazed or improperly harvested for hay, big bluestem, indiangrass, little bluestem, and switchgrass decrease in abundance and sideoats grama, tall dropseed, Kentucky bluegrass, and annual and perennial weeds increase. If overgrazing continues for many years, the abundance of the less desirable plants, especially Kentucky bluegrass, buckbrush, snowberry, and sumac, increases. Deferred grazing helps to maintain or improve the range.

This soil is suited to the moderately drought resistant trees grown as windbreaks. If competing vegetation is removed by good site preparation and timely control measures, the seedlings generally survive. Planting the rows of trees on the contour and using strips of sod or a cover crop between the rows reduce the erosion hazard. Some seedlings require supplemental water during dry periods.

The moderately slow permeability of this soil is a limitation on sites for septic tank absorption fields, but this limitation generally can be overcome by increasing the size of the absorption field. On sites for sewage lagoons, some grading is needed to modify the slope and shape the lagoon. Lining or sealing the lagoon helps to prevent seepage. Strengthening the foundations of dwellings and backfilling with coarse material help to prevent the structural damage caused by shrinking and swelling. Local roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to ensure better performance. Mixing the base material with additives, such as hydrated lime, helps to prevent shrinking and swelling.

This soil is assigned to capability units IIIe-1, dryland, and IIIe-4, irrigated; pasture and hayland suitability group A-2; Silty range site; and windbreak suitability group 3.

HcD—Hastings silt loam, 6 to 11 percent slopes. This deep, strongly sloping, well drained soil is on the sides of upland drainageways and on the side slopes of upland breaks to stream terraces or bottom lands. The soil formed in loess. Areas are irregular in shape and range from 5 to 30 acres in size.

Typically, the surface layer is dark grayish brown, very friable silt loam about 6 inches thick. The subsoil is silty clay loam about 24 inches thick. The upper part is grayish brown and friable, the next part is brown and firm, and the lower part is pale brown and firm. The underlying material to a depth of about 60 inches is very pale brown and light yellowish brown, calcareous silt loam. In places the surface layer is silty clay loam less than 5 inches thick. In some areas the soil is dark to a depth of less than 8 inches. In other areas the thickness of the surface layer combined with that of the subsoil is less than 26 inches.

Included with this soil in mapping are small areas of Geary, Hobbs, Kezan, and Uly soils and severely eroded soils. Geary soils have reddish layers and are lower on side slopes than this Hastings soil. Hobbs and Kezan soils are stratified and are at the bottoms of drainageways. Uly soils are steeper than this Hastings soil and have less clay in the subsoil. The severely eroded soils are lighter in color than this Hastings soil because the subsoil or underlying material is exposed. Included soils make up as much as 15 percent of this unit.

Permeability is moderately slow in this Hastings soil. Available water capacity is high, and the water intake rate for irrigation is moderately low. Runoff is medium or rapid. Generally, the surface layer is moderate in organic matter content and high in natural fertility, and tilth is good. In the eroded areas, however, tilth is poor, organic matter content is low, and the amount of available phosphates is deficient. The shrink-swell potential is moderate in the surface layer and high in the subsoil.

Nearly all of the acreage is grassland used for grazing or hay. A few small areas are used for dryland farming.

If used for dryland farming, this soil is poorly suited to corn and grain sorghum. It is better suited to small grain and legumes and grasses than to row crops. Water erosion is difficult to control when the soil is cultivated and the surface is not protected. Thus, including row crops in the cropping sequence increases the erosion hazard. Terraces, contour farming, and grassed waterways reduce the hazards of runoff and water erosion. Conservation tillage practices, such as stubble mulching and till planting, that leave crop residue on the surface help to control water erosion and conserve soil moisture. Leaving crop stubble standing throughout winter helps to control soil blowing. Also, the stubble traps blowing snow, thus providing additional soil moisture. Returning crop residue and green manure crops to the soil and applying feedlot manure increase the organic matter content and improve fertility, tilth, and water infiltration. Additional phosphates are needed in the eroded areas.

If irrigated, this soil is suited to close-growing crops, such as small grain and grasses and legumes. Irrigation of this soil by a gravity system is impractical because of the difficulty of controlling the water. The steep adjacent slopes and the channeled adjacent bottom lands limit the use of a sprinkler system. If a center-pivot sprinkler system is used, grass-covered terraces help to intercept runoff and prevent excessive water erosion, especially in wheel tracks. The grass on the terraces helps to keep the wheels from making deep furrows in the soil. Additional crop residue is available because of irrigation. Leaving the residue on the surface by applying conservation tillage practices, such as till planting, helps to control water erosion. The rate of water application should be suited to the moderately low intake rate of this soil.

This soil is suited to pasture and hay, which can be rotated with other crops. A cover of introduced grasses, generally bromegrass alone or in a mixture with alfalfa, is effective in controlling water erosion. Overgrazing reduces the extent of the protective plant cover, lowers the quality of the plants, and increases the hazards of runoff and erosion. Proper stocking rates, rotation grazing, and timely applications of nitrogen fertilizer keep the plants and the soil in good condition.

This soil is suited to range. A cover of range plants is very effective in controlling water erosion. The native plant community is mostly mid and tall grasses dominated by big bluestem, porcupinegrass, little bluestem, indiangrass, sideoats grama, and switchgrass. When the plants are overgrazed or improperly harvested for hay, big bluestem, indiangrass, little bluestem, and switchgrass decrease in abundance and sideoats grama, tall dropseed, Kentucky bluegrass, and annual and perennial weeds increase. If overgrazing continues for many years, the abundance of the less desirable plants, especially Kentucky bluegrass, buckbrush, snowberry, and sumac, increases. Deferred grazing helps to maintain or improve the range.

This soil is suited to the moderately drought resistant trees grown as windbreaks. If competing vegetation is removed by good site preparation and timely control measures, the seedlings generally survive, but the growth rate is slower than that on some less sloping soils. Planting the rows of trees on the contour and using strips of sod or a cover crop between the rows reduce the erosion hazard. Some seedlings require supplemental water during dry periods.

The slope and the moderately slow permeability of this soil are limitations on sites for septic tank absorption fields. The moderately slow permeability generally can be overcome by increasing the size of the absorption field. Land shaping and installing the absorption field on the contour help to ensure proper performance. On sites for sewage lagoons, some grading is needed to modify the slope and shape the lagoon. Lining or sealing the lagoon helps to prevent seepage. Dwellings should be designed so that they conform to the natural slope of the land or the site should be graded. Strengthening the foundations and backfilling with coarse material help to prevent the structural damage caused by shrinking and swelling. Cuts and fills are generally needed to provide a suitable grade for local roads. The roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to ensure better performance. Mixing the base material with additives, such as hydrated lime, helps to prevent shrinking and swelling.

This soil is assigned to capability units IVe-1, dryland, and IVe-4, irrigated; pasture and hayland suitability group A-2; Silty range site; and windbreak suitability group 3.

HdC2—Hastings silty clay loam, 3 to 6 percent slopes, eroded. This deep, gently sloping, well drained soil is mainly on the short sides of upland drainageways and on upland divides. In some areas it is on the side slopes of upland breaks to stream terraces. Rills and small gullies are common. The soil formed in loess. Areas are somewhat oblong or irregular in shape and range from 5 to about 480 acres in size.

Typically, the surface layer is grayish brown, firm silty clay loam about 7 inches thick. In most areas erosion has removed some or all of the original dark surface layer, and in places it has removed part of the subsoil. In areas where the original surface layer has not been removed, it has been mixed by tillage with the upper part of the subsoil. The subsoil is silty clay loam about 24 inches thick. The upper part is brown and firm, and the lower part is pale brown and friable. The underlying material to a depth of about 60 inches is light olive brown, light yellowish brown, and pale yellow silt loam. It is calcareous in the lower part. In a few places the underlying material has been exposed by erosion or by

deep cuts made during land grading. In some areas lime is within a depth of 36 inches, and in a few areas it is at the surface.

Included with this soil in mapping are small areas of eroded Crete soils, eroded Geary soils, and Hobbs soils. Crete soils are in positions on the landscape similar to those of this Hastings soil. They have more clay in the subsoil than the Hastings soil and are not so well drained. Geary soils have reddish layers. They are lower on the sides of upland drainageways than this Hastings soil. Hobbs soils are stratified and are at the bottoms of drainageways. Included soils make up as much as 10 percent of the unit.

Permeability is moderately slow in this Hastings soil. Available water capacity is high. Moisture is released readily to plants, and the water intake rate for irrigation is low. Runoff is medium. Natural fertility is medium, and organic matter content is low because of the loss of the original surface layer through erosion. The amount of available phosphates is deficient. Tilth is poor because of the low organic matter content and the silty clay loam surface layer. The shrink-swell potential is high. The surface layer is slightly acid to mildly alkaline, depending on the extent of erosion.

Nearly all the acreage is farmed. About half of the farmed areas are irrigated, and about half are used for dryland farming. A few areas have been reseeded to introduced or native grasses and are used for pasture and hay or for range.

If used for dryland farming, this soil is suited to small grain, grain sorghum, and grasses and legumes. Water erosion is the main hazard. Terraces, contour farming, and grassed waterways help to control the runoff that causes the formation of rills and gullies. Conservation tillage practices, such as stubble mulching and till planting, that leave crop residue on the surface help to control water erosion and conserve soil moisture. Leaving crop stubble standing throughout winter helps to control soil blowing. Also, the stubble traps blowing snow, thus providing additional soil moisture. The soil puddles after hard rains or if it is worked when too wet. As it dries, the soil becomes hard. A cropping system dominated by such close-growing crops as wheat, alfalfa, or grasses improves soil tilth and water infiltration and helps to control erosion. Returning crop residue and green manure crops to the soil and applying feedlot manure increase the organic matter content and improve natural fertility, tilth, and water infiltration. Phosphorus is needed if alfalfa is grown.

If irrigated, this soil is suited to grasses and to legumes, such as alfalfa. If erosion is controlled, the soil is suited to irrigated corn, grain sorghum, and soybeans. The sprinkler system is the best method of irrigation on this soil. Contour bench leveling is suited to some of the less sloping areas irrigated by a gravity system. The slopes interfere with the control of runoff and of the erosion caused by rainfall and irrigation. If a center-pivot sprinkler system is used, grass-covered terraces help to intercept runoff and prevent excessive water erosion, especially in wheel tracks. The grass on the terraces helps to keep wheels from making deep furrows in the soil. Additional crop residue is available because of irrigation. Conservation tillage practices, such as till planting and disking, keep all or part of the residue on the surface and thus help to control water erosion and conserve soil moisture. The rate of water application should be suited to the low intake rate of this soil.

This soil is suited to pasture and hay, which can be rotated with other crops. A cover of introduced grasses, generally bromegrass or orchardgrass or a mixture of one of those with alfalfa, is effective in controlling erosion. Overgrazing reduces the extent of the protective plant cover, lowers the quality of the plants, and increases the hazards of runoff and erosion. Proper stocking rates, rotation grazing, and timely applications of nitrogen fertilizer keep the plants and the soil in good condition.

This soil is suited to range. A cover of range plants is very effective in controlling water erosion. The native plant community is mostly mid and tall grasses dominated by big bluestem, porcupinegrass, little bluestem, indiangrass, sideoats grama, and switchgrass. When the plants are overgrazed or improperly harvested for hay, big bluestem, indiangrass, little bluestem, and switchgrass decrease in abundance and sideoats grama, tall dropseed, Kentucky bluegrass, and annual and perennial weeds increase. If overgrazing continues for many years, the abundance of the less desirable plants, especially Kentucky bluegrass, buckbrush, snowberry, and sumac, increases. Deferred grazing helps to maintain or improve the range.

This soil is suited to the moderately drought tolerant trees grown as windbreaks. If competing vegetation is removed by good site preparation and timely control measures, the seedlings generally survive. Planting the rows of trees on the contour and planting a cover crop between the rows reduce the erosion hazard. Some seedlings require supplemental water during dry periods.

The moderately slow permeability of this soil is a limitation on sites for septic tank absorption fields, but this limitation generally can be overcome by increasing the size of the absorption field. On sites for sewage lagoons, some grading is needed to modify the slope and shape the lagoon. Lining or sealing the lagoon helps to prevent seepage. Strengthening the foundations of dwellings and backfilling with coarse material help to prevent the structural damage caused by shrinking and swelling. Local roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to ensure better performance. Mixing the base material with additives, such as hydrated lime, helps to prevent shrinking and swelling.

This soil is assigned to capability units IIIe-8, dryland, and IIIe-3, irrigated; pasture and hayland suitability group A-2; Silty range site; and windbreak suitability group 3.

HdC3—Hastings silty clay loam, 3 to 6 percent slopes, severely eroded. This deep, gently sloping, well drained soil is on the short sides of upland drainageways. Areas are somewhat narrow and irregular in shape and range from 5 to about 100 acres in size.

Typically, the surface layer is grayish brown, firm silty clay loam about 5 inches thick. In most areas erosion has removed all of the original dark surface layer and most of the subsoil. Tillage has mixed the remaining subsoil with the underlying material. The subsoil is light brownish gray, firm silty clay about 3 inches thick. The underlying material extends to a depth of about 60 inches or more. It is calcareous. It is light olive brown and pale olive silty clay loam in the upper part and pale olive silt loam in the lower part. In some areas lime is at the surface.

Included with this soil in mapping are small areas of eroded Geary soils, eroded Crete soils, and Hobbs soils. Geary soils are lower on side slopes than this Hastings soil and have reddish layers. Crete soils have more clay in the subsoil than this Hastings soil. They are in landscape positions similar to those of this Hastings soil. Hobbs soils are stratified and are at the bottoms of drainageways. Included soils make up as much as 10 percent of this unit.

Permeability is moderately slow in this Hastings soil, and the water intake rate for irrigation is low. Available water capacity is high. Runoff is medium. Tilth is poor because of a low organic matter content and the severely eroded surface layer. Natural fertility and organic matter content are low because of the loss of the original surface layer through erosion. The amount of available phosphates is deficient. The shrink-swell potential is high. The surface layer is neutral to moderately alkaline, depending on the extent of erosion.

Nearly all of the acreage is used for dryland crops. Some is used for irrigated crops. A few areas have been reseeded to introduced or native grasses and are used for pasture and hay or for range.

If used for dryland farming, this soil is poorly suited to corn and grain sorghum. It is better suited to legumes and grasses than to row crops. Sheet and gully erosion is difficult to control when this soil is cultivated and the surface is not protected. Terraces, contour farming, and grassed waterways help to reduce the hazards of runoff and water erosion. Conservation tillage practices, such as stubble mulching and till planting, that leave crop residue on the surface help to control water erosion and conserve soil moisture. Leaving crop stubble standing throughout winter helps to control soil blowing. Also, the stubble traps blowing snow, thus providing additional soil moisture. The soil is difficult to work because of the silty clay loam surface layer. Compaction and puddling occur if the soil is tilled when it is too wet. As the soil dries, it becomes hard and cannot be easily worked. Therefore, tillage is limited to a narrow range of moisture content. Returning crop residue and green manure crops to the soil and applying feedlot manure increase the organic matter content and the rate of water infiltration and improve fertility and tilth. Phosphorus fertilizer is needed if alfalfa is grown.

If irrigated, this soil is suited to grasses and to legumes, such as alfalfa. If erosion is controlled, the soil is suited to irrigated corn, grain sorghum, and soybeans. The sprinkler system is the best method of irrigation on this soil. The slopes interfere with the control of runoff and of the erosion caused by rainfall and irrigation. If a center-pivot sprinkler system is used, grass-covered terraces help to intercept runoff and prevent excessive water erosion, especially in wheel tracks. The grass on the terraces helps to keep the wheels from making deep furrows in the soil. Additional crop residue is available because of irrigation. Conservation tillage practices, such as till planting and disking, keep all or part of the residue on the surface and thus help to control water erosion and conserve soil moisture. The rate of water application should be suited to the low intake rate of this soil.

This soil is suited to pasture and hay, which can be rotated with other crops. A cover of introduced grasses, generally bromegrass or orchardgrass or a mixture of one of those with alfalfa, is effective in controlling erosion. Overgrazing reduces the extent of the protective plant cover, lowers the quality of the plants, and increases the runoff rate and soil losses. Proper stocking rates, rotation grazing, and timely applications of nitrogen fertilizer keep the plants and the soil in good condition.

This soil is suited to range. A cover of range plants is very effective in controlling water erosion. The native plant community is mostly mid and tall grasses dominated by big bluestem, porcupinegrass, little bluestem, indiangrass, sideoats grama, and switchgrass. When the plants are overgrazed or improperly harvested for hay, big bluestem, indiangrass, little bluestem, and switchgrass decrease in abundance and sideoats grama, tall dropseed, Kentucky bluegrass, and annual and perennial weeds increase. If overgrazing continues for many years, the abundance of the less desirable plants, especially Kentucky bluegrass, buckbrush, snowberry, and sumac, increases. Deferred grazing helps to maintain or improve the range.

This soil is suited to the moderately drought tolerant trees grown as windbreaks. If competing vegetation is removed by good site preparation and timely control measures, seedlings generally survive, but the growth rate is slower than that on some less eroded and less sloping soils. Planting the rows of trees on the contour and planting a cover crop between the rows reduce the erosion hazard. Some seedlings require supplemental water during dry periods.

The moderately slow permeability of this soil is a limitation on sites for septic tank absorption fields, but this limitation generally can be overcome by increasing the size of the absorption field. On sites for sewage lagoons, some grading is needed to modify the slope and shape the lagoon. Lining or sealing the lagoon helps to prevent seepage. Strengthening the foundations of dwellings and backfilling with coarse material help to prevent the structural damage caused by shrinking and swelling. Local roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing a coarser grained base material helps to ensure better performance. Mixing the base material with additives, such as hydrated lime, helps to prevent shrinking and swelling.

This soil is assigned to capability units IIIe-8, dryland, and IIIe-3, irrigated; pasture and hayland suitability group A-3; Silty range site; and windbreak suitability group 3.

HdD2—Hastings silty clay loam, 6 to 11 percent slopes, eroded. This deep, strongly sloping, well drained soil is on the short sides of upland drainageways and on the side slopes of upland breaks to stream terraces or bottom lands. Rills and gullies are common. The soil formed in loess. Areas are irregular in shape and range from 5 to 200 acres in size.

Typically, the surface layer is grayish brown, firm silty clay loam about 7 inches thick. In most areas erosion has removed the original surface layer of dark silt loam, and in places it has removed part of the subsoil. The part of the original surface layer that has not been removed has been mixed with the subsoil by tillage. The subsoil is silty clay loam about 16 inches thick. The upper part is brown and firm, and the lower part is light yellowish brown. The underlying material to a depth of about 60 inches is pale yellow and very pale brown silt loam. It is calcareous in the lower part. In places erosion has exposed the underlying material. In some areas lime is within a depth of 36 inches, and in other areas it is at the surface.

Included with this soil in mapping are small areas of eroded Crete and Geary soils and Uly and Hobbs soils. Crete soils are less sloping than this Hastings soil and have more clay in the subsoil. Geary soils have reddish layers and are on side slopes below this Hastings soil. Hobbs soils are stratified and are at the bottoms of drainageways. Uly soils are steeper than this Hastings soil and have less clay in the subsoil. Included soils make up as much as 15 percent of this unit.

Permeability is moderately slow in this Hastings soil. Available water capacity is high, and the water intake rate for irrigation is low. Runoff is medium or rapid. The surface layer is slightly acid to moderately alkaline, depending on the extent of erosion. Natural fertility is medium, and organic matter content is low because of the loss of the original surface layer through erosion. The amount of available phosphates is deficient. Tilth is poor. The shrink-swell potential is high.

Nearly all of the acreage is used for dryland farming. Only a few areas are irrigated. Some areas have been reseeded to introduced or native grasses and are used for pasture and hay or for range.

If used for dryland farming, this soil is poorly suited to corn and grain sorghum. It is better suited to legumes and grasses than to row crops. Sheet and gully erosion are difficult to control when this soil is cultivated and the surface is not protected. Thus, growing row crops increases the hazard of erosion. Terraces, contour farming, and grassed waterways reduce the hazards of runoff and water erosion. Conservation tillage practices, such as stubble mulching and till planting, that leave crop residue on the surface help to control water erosion and conserve soil moisture. Leaving crop stubble standing throughout winter helps to control soil blowing. Also, the stubble traps blowing snow, thus providing additional soil moisture. This soil puddles after hard rains or if it is worked when too wet. As the soil dries, it becomes hard. Returning crop residue and green manure crops to the soil and applying feedlot manure increase the organic matter content and improve fertility, tilth, and water infiltration. Phosphorus fertilizer is needed if alfalfa is grown.

If irrigated, this soil is suited to close-growing crops, such as small grain and legumes and grasses. Irrigation by the gravity system is unsuitable because of the difficulty of controlling the water. If a center-pivot sprinkler system is used, grass-covered terraces help to intercept runoff and prevent excessive water erosion, especially in wheel tracks. The grass on the terraces keeps the wheels from making deep furrows in the soil. Additional crop residue is available because of irrigation. Leaving the residue on the surface conserves soil moisture, improves tilth, and increases the water intake rate. The rate of water application should be suited to the low water intake rate of this soil.

This soil is suited to pasture and hay, which can be rotated with other crops. A cover of introduced grasses, generally bromegrass or a mixture of bromegrass and alfalfa, greatly reduces the hazard of water erosion. Overgrazing reduces the extent of the protective plant cover, lowers the quality of the plants, and increases the hazards of runoff and erosion. Proper stocking rates, rotation grazing, and timely applications of nitrogen and phosphorus fertilizer keep the plants and the soil in good condition.

This soil is suited to range. A cover of range plants is very effective in controlling water erosion. The native plant community is mostly mid and tall grasses dominated by big bluestem, indiangrass, little bluestem, porcupinegrass, sideoats grama, and switchgrass. When the plants are overgrazed or improperly harvested for hay, big bluestem, little bluestem, indiangrass, and switchgrass decrease in abundance and sideoats grama,

tall dropseed, Kentucky bluegrass, and annual and perennial weeds increase. If overgrazing continues for many years, the abundance of the less desirable plants, especially Kentucky bluegrass, buckbrush, snowberry, and sumac, increases. Deferred grazing helps to maintain or improve the native grasses. Earth dams in drainageways can store runoff for use by livestock.

This soil is suited to the moderately drought tolerant trees grown as windbreaks. If competing vegetation is removed by good site preparation and timely control measures, the seedlings generally survive, but the growth rate is slower than that on some less sloping soils. Planting the rows of trees on the contour, terracing, and planting a cover crop between the rows reduce the water erosion hazard. Some seedlings require supplemental water during dry periods.

The slope and the moderately slow permeability of this soil are limitations on sites for septic tank absorption fields. The moderately slow permeability generally can be overcome by increasing the size of the absorption field. Land shaping and installing the absorption field on the contour help to ensure proper performance. On sites for sewage lagoons, extensive grading is needed to modify the slope and shape the lagoon. Lining or sealing the lagoon helps to prevent seepage. Dwellings should be designed so that they conform to the natural slope of the land, or the site should be graded. Strengthening the foundations and backfilling with coarse material help to prevent the structural damage caused by shrinking and swelling. Cuts and fills generally are needed to provide a suitable grade for local roads. The roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to ensure better performance. Mixing the base material with additives, such as hydrated lime, helps to prevent shrinking and swelling.

This soil is assigned to capability units IVe-8, dryland, and IVe-3, irrigated; pasture and hayland suitability group A-2; Silty range site; and windbreak suitability group 3.

He—Hobbs silt loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil is mostly on long and narrow bottom lands along drainageways. In some areas it is on the slightly higher bottom lands between frequently flooded bottom lands and terraces or uplands. The soil formed in stratified, silty alluvium. It is occasionally flooded. Areas range from 5 to more than 200 acres in size.

Typically, the surface layer is dark gray, friable silt loam about 9 inches thick. The underlying material is silt loam to a depth of about 60 inches. It is stratified grayish brown and dark grayish brown in the upper part, dark gray and grayish brown in the next part, and stratified dark grayish brown and light gray in the lower part. In some areas the surface layer is silty clay loam or fine sandy loam. This layer varies in color and texture, depending on the source of recent deposition. In few areas it is underlain by sand.

Included with this soil in mapping are small areas of Muir and Kezan soils; frequently flooded, silty soils, and soils on short, steep slopes. Muir soils have a subsoil and are on terraces. The frequently flooded, silty soils are slightly lower on the landscape than this Hobbs soil. Kezan soils are poorly drained and have a seasonal high water table. The soils on short, steep slopes are on streambanks separating the bottom lands from the terraces or uplands. Included soils make up as much as 15 percent of this unit.

Permeability and the water intake rate for irrigation are moderate in this Hobbs soil. Available water capacity is high, and moisture is released readily to plants. Runoff is slow. Tilth is good. Organic matter content is moderate, and natural fertility is high. The shrink-swell potential is low.

Most of the acreage is farmed. The rest is grassland used for grazing, hay, or wildlife habitat. Most of the farmed areas are used for dryland crops, but some are irrigated.

If used for dryland farming, this soil is suited to sorghum, small grain, soybeans, corn, and legumes and grasses. Occasional flooding, although brief, sometimes delays planting and tillage or damages crops, especially alfalfa and small grain, by scouring and sedimentation. In dry years, however, some areas of row crops benefit from the extra moisture provided by the flooding. If damaged by flooding in the spring, the crops that have a short growing season can be replanted. In most areas floodwater can be controlled by levees, intercepted by diversions, or drained by ditches. Returning crop residue and green manure crops to the soil and applying feedlot manure increase the organic matter content and improve fertility, tilth, and water infiltration. Immediate incorporation of the feedlot manure into the soil is needed so that flooding does not carry the manure downstream.

If irrigated, this soil is suited to corn, grain sorghum, soybeans, and grasses and legumes. Using an application rate suited to the moderate water intake rate of this soil conserves irrigation water. Use of a center-pivot irrigation system commonly is limited because of the adjacent streams and steep upland soils. Where a gravity system is used, flooding occasionally washes out the furrows. Levees and diversions can lessen this hazard. If a gravity system is used, a tailwater recovery system is needed to conserve irrigation water and improve the efficiency of water application.

This soil is suited to pasture and hay, which can be rotated with other crops. Introduced grasses, generally bromegrass and orchardgrass or a mixture of those grasses with alfalfa or birdsfoot trefoil, are suited. Occasional flooding damages some grasses and introduces weeds. Controlling weeds and grazing allows desirable grasses to reseed. Levees and diversions are

needed in some areas to help keep the plants in good condition. Delayed grazing after floods helps to prevent compaction.

This soil is suited to range. The native plant community is mostly mid and tall grasses and grasslike plants dominanted by big bluestem, little bluestem, switchgrass, and various sedges. When the plants are overgrazed or improperly harvested for hay, some areas of the soil are dominated by Kentucky bluegrass, sedges, and many annual and perennial weeds. Also, woody plants, including snowberry and buckbrush, invade the site. Brush management and controlled burning in some areas help to remove the woody plants. Deferred grazing helps to keep the grasses in good condition. Shade-tolerant grasses can be seeded in areas covered by many trees.

This soil is suited to the trees grown as windbreaks. Flooding occasionally damages new plantings. Once seedlings are established, however, the additional moisture is beneficial. Control of competing grasses, weeds, and shrubs increases the survival rate of seedlings. Young trees should be protected from grazing.

Because of the flooding, this soil is generally unsuitable as a site for septic tank absorption fields or dwellings. A suitable alternative site is needed. Diking helps to protect sewage lagoons from flooding. Constructing local roads on suitable, well compacted fill material above flood levels and providing adequate side ditches and culverts help to prevent damage caused by flooding. The roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to ensure better performance.

This soil is assigned to capability units IIw-3, dryland, and IIw-6, irrigated; pasture and hayland suitability group A-1; Silty Overflow range site; and windbreak suitability group 1.

Hf—Hobbs silt loam, channeled. This deep, nearly level, well drained soil is on frequently flooded bottom lands along perennial and intermittent streams. Many areas are broken by meandering channels and steep streambanks. The soil formed in stratified, silty alluvium. Areas are long and narrow and range from 70 to more than 2,000 acres in size.

Typically, the surface layer is stratified dark grayish brown and light brownish gray, very friable silt loam about 9 inches thick. The underlying material extends to a depth of 60 inches or more. It is stratified dark grayish brown and light brownish gray silt clay loam in the upper part, dark grayish brown and grayish brown silt loam in the next part, and stratified brown and pale brown loam in the lower part. In some areas the surface layer is silty clay loam or fine sandy loam. This layer varies in color and texture, depending on the source of recent deposition. In some areas it is underlain by sand.

Included with this soil in mapping are small areas of occasionally flooded soils, Kezan soils, and soils on short, steep slopes. The occasionally flooded soils are slightly higher on the landscape than this Hobbs soil. Kezan soils are poorly drained, have a seasonal high water table, and are mottled. The soils on short, steep slopes are on the streambanks separating the bottom lands from the terraces or uplands. Included soils make up as much as 15 percent of this unit.

Permeability is moderate in this Hobbs soil. Available water capacity is high, and moisture is released readily to plants. Runoff is slow. Tilth is good. Organic matter content is moderate, and natural fertility is high. The shrink-swell potential is low.

Nearly all of the acreage is grassland or woodland and is used for grazing or wildlife habitat. This soil is generally unsuited to cultivated crops because of the frequent flooding and the steep slopes along meandering channels.

This soil is suited to introduced or domestic grasses for pasture and hay. Such cool-season grasses as bromegrass and orchardgrass are suitable, alone or in a mixture with alfalfa or birdsfoot trefoil. Sediment deposited by floodwater partly covers some plants, reducing their vigor and retarding their growth. Control of weeds and grazing allows desirable grasses to reseed. Levees and diversions are needed in some areas. Delayed grazing after floods helps to prevent compaction.

This soil is suited to range. The native plant community is mostly mid and tall grasses and grasslike plants dominated by big bluestem, little bluestem, switchgrass, and various sedges. When the plants are overgrazed or improperly harvested for hay, some areas are dominated by Kentucky bluegrass, sedges, and many annual and perennial weeds. Also, woody plants, including snowberry and buckbrush, invade the site. Brush management and controlled burning help to remove the woody plants. Frequent flooding, although brief, causes sedimentation, channeling, and deposition of debris and weed seeds. Controlling weeds and grazing allows desirable grasses to reseed. Delayed grazing after floods helps to prevent compaction.

Because of the flooding, this soil is unsuited to most of the trees grown as windbreaks. Onsite investigation is needed to determine the suitability for special plantings. Only the trees and shrubs tolerant of flooding are suited. Many trees become established naturally. Once the trees are established, the additional moisture from flooding is beneficial.

This soil is suited to habitat for woodland, openland, and rangeland wildlife (fig. 10). The potential is fair for grasses and legumes, wild herbaceous plants, hardwood trees, and coniferous plants and shrubs. It is poor for grain and seed plants. The species selected for planting should be those that are tolerant of flooding. Hardwood trees grow in all areas of this soil except for the stream

channels. Woodland wildlife, such as tree squirrels, cottontail rabbits, raccoons, and white-tailed deer, use areas of this soil for year-round habitat. Openland wildlife, such as pheasants and quail, use the habitat for escape and shelter. Some wetland wildlife, such as ducks, use the water in the streams, old oxbows, and sand or gravel pits. Hunting and fishing are the main recreation uses.

Because of the flooding, this soil is not suitable as a site for septic tank absorption fields or dwellings. A suitable alternative site is needed. Diking helps to protect sewage lagoons from flooding. Constructing local roads on suitable, well compacted fill material above flood levels and providing adequate side ditches and culverts help to prevent the damage caused by flooding. The roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to ensure better performance.

This soil is assigned to capability unit VIw-1, dryland; pasture and hayland suitability group A-1; Silty Overflow range site; and windbreak suitability group 10.

HhD2—Holder silty clay loam, 6 to 11 percent slopes, eroded. This deep, strongly sloping, well drained soil is on the short sides of upland drainageways and on the side slopes of upland breaks to stream terraces or bottom lands. Rills and gullies are common. Areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is grayish brown, firm silty clay loam about 5 inches thick. In most areas erosion has removed the original surface layer of dark silt loam, and in places it has removed part of the subsoil. The part of the original surface layer that has not been removed has been mixed by tillage with the subsoil. The subsoil is silty clay loam about 13 inches thick. The upper part is brown and firm, and the lower part is light olive brown. The underlying material to a depth of about

Figure 10.—Good natural habitat for wildlife in an area of Hobbs silt loam, channeled, along the West Fork of the Big Blue River.

60 inches is light yellowish brown and pale brown silt loam. It is calcareous in the lower part. In places erosion has exposed the underlying material. In some areas lime is within a depth of 36 inches, and in other areas it is at the surface.

Included with this soil in mapping are small areas of eroded Hastings soils, eroded Geary soils, and Uly and Hobbs soils. Hastings soils are less sloping than this Holder soil and have more clay in the subsoil. Geary soils have reddish layers and are on side slopes below this Holder soil. Hobbs soils are stratified and are at the bottoms of drainageways. Uly soils are steeper than this Holder soil and have less clay in the subsoil. Included soils make up as much as 15 percent of this unit.

Permeability is moderate in this Holder soil. Available water capacity is high, and the water intake rate for irrigation is low. Runoff is medium to rapid. The surface layer is slightly acid to moderately alkaline, depending on the extent of erosion. Natural fertility is medium, and organic matter content is low because of the loss of the original surface layer through erosion. The amount of available phosphates is deficient. Tilth is poor. The shrink-swell potential is moderate.

Nearly all of the acreage is used for dryland farming. A few areas are irrigated. Some have been reseeded to introduced or native grasses and are used for pasture and hay or for range.

If used for dryland farming, this soil is poorly suited to corn and grain sorghum. It is better suited to legumes and grasses than to row crops. Sheet and gully erosion are difficult to control when this soil is cultivated and the surface is not protected. Planting row crops increases the hazard of erosion. Terraces, contour farming, and grassed waterways reduce the runoff rate and the susceptibility to water erosion. Conservation tillage practices, such as stubble mulching and till planting, that leave crop residue on the surface help to control water erosion and conserve soil moisture. Leaving crop stubble standing throughout winter traps blowing snow, thus providing additional soil moisture. Returning crop residue and green manure crops to the soil and applying feedlot manure increase the organic matter content and improve fertility, tilth, and water infiltration. Phosphorus fertilizer is needed if alfalfa is grown.

If irrigated, this soil is suited to close-growing crops, such as small grain and legumes and grasses. Irrigation by a gravity system is unsuitable because of the difficulty of controlling the water. If a center-pivot sprinkler system is used, grass-covered terraces help to intercept runoff and prevent excessive water erosion, especially in wheel tracks. The grass on the terraces keeps wheels from making deep furrows in the soil. Additional crop residue is available because of irrigation. Leaving the residue on the surface conserves soil moisture, improves tilth, and increases the water intake rate. The rate of water application should be suited to the low intake rate of this soil.

This soil is suited to pasture and hay, which can be rotated with other crops. A cover of introduced grasses, generally bromegrass or a mixture of bromegrass and alfalfa, greatly reduces the hazard of water erosion. Overgrazing reduces the extent of the protective plant cover, lowers the quality of the plants, and increases the hazards of runoff and erosion. Proper stocking rates, rotation grazing, and timely applications of nitrogen and phosphorus fertilizer keep the plants and the soil in good condition.

This soil is suited to range. A cover of range plants is very effective in controlling water erosion. The native plant community is mostly mid and tall grasses dominated by big bluestem, indiangrass, little bluestem, porcupinegrass, sideoats grama, and switchgrass. When the plants are overgrazed or improperly harvested for hay, big bluestem, little bluestem, indiangrass, and switchgrass decrease in abundance and sideoats grama, tall dropseed, Kentucky bluegrass, and annual and perennial weeds increase. If overgrazing continues for many years, the abundance of the less desirable plants, especially Kentucky bluegrass, buckbrush, snowberry, and sumac, increases. Deferred grazing helps to maintain or improve the native grasses and keeps the soil in good condition. Earth dams in drainageways can store runoff water for use by livestock.

This soil is suited to the moderately drought tolerant trees grown as windbreaks. If competing vegetation is removed by good site preparation and timely control measures, the seedlings generally survive. Planting the row of trees on the contour and planting a cover crop between the rows reduce the erosion hazard. Some seedlings require supplemental water during dry periods.

The slope and the moderate permeability of this soil are limitations on sites for septic tank absorption fields. The moderate permeability generally can be overcome by increasing the size of the absorption field. Land shaping and installing the absorption field on the contour help to ensure proper performance. On sites for sewage lagoons, extensive grading is needed to modify the slope and shape the lagoon. Lining or sealing the lagoon helps to prevent seepage. Dwellings should be designed so that they conform to the natural slope of the land, or the site shall be graded. Strengthening the foundations and backfilling with coarse material help to prevent the structural damage caused by shrinking and swelling. Cuts and fills generally are needed to provide a suitable grade for local roads. The roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to ensure better performance. Mixing the base material with additives, such as hydrated lime, helps to prevent shrinking and swelling.

This soil is assigned to capability units IVe-8, dryland, and IVe-3, irrigated; pasture and hayland suitability group A-2; Silty range site; and windbreak suitability group 3.

Ke—Kezan silt loam, channeled. This deep, nearly level, poorly drained soil is on frequently flooded bottom lands along intermittent streams. Many areas are broken by meandering channels and steep streambanks. The soil formed in alluvial material. Areas are long and narrow and range from 30 to more than 100 acres in size.

Typically, the surface layer is stratified grayish brown and gray, friable silt loam about 5 inches thick. The underlying material to a depth of about 60 inches is silty clay loam. The upper part is dark gray and gray, the next part is stratified dark grayish brown and grayish brown and is mottled, and the lower part is stratified light brownish gray and dark grayish brown and is mottled. In some areas the surface layer is silty clay loam. This layer varies in color and texture, depending on the source of recent deposition. In some areas it is underlain by sandy material.

Included with this soil in mapping are small areas of Hobbs soils and areas of soils on short, steep slopes. Hobbs soils are occasionally flooded, are well drained, and are slightly higher on the landscape than this Kezan soil. They do not have mottles. The soils on short, steep slopes are on the streambanks separating the bottom lands from the uplands. Included soils make up as much as 15 percent of this unit.

Permeability is moderate in this Kezan soil. Available water capacity is high, and moisture is released readily to plants. Runoff is slow. A seasonal high water table is at a depth of 1 to 2 feet, mainly from April through July. Tilth is good, organic matter content is moderate, and natural fertility is high. The shrink-swell potential is low.

Nearly all of the acreage is grassland or woodland. It is used for pasture, hay, or wildlife habitat. This soil is generally not suited to cultivated crops because of the frequent flooding, the seasonal high water table, and the steep slopes along meandering channels.

This soil is suited to some introduced or domestic grasses, especially reed canarygrass and creeping foxtail, used for pasture and hay. Excessive wetness limits the choice of pasture grasses and legumes. Grazing when the water table is highest results in damage to the grass, a rough soil surface, and difficulty in mowing for hay. The wetness hinders seeding and makes delayed seeding and grazing necessary until the water table is lower.

This soil is suited to range and to native hay. The native plant community is mostly tall and mid grasses and grasslike plants dominated by big bluestem, little bluestem, indiangrass, switchgrass, prairie cordgrass, and various sedges. When the plants are overgrazed or improperly harvested for hay, some areas are dominated by timothy, redtop, foxtail barley, clover, sedges, and rushes. Overgrazing when the soil is wet causes surface compaction and the formation of small mounds. Restricted use during very wet periods helps to maintain the quality and extent of the native plants.

This soil generally is not suited to most of the trees grown as windbreaks. Onsite investigation is needed to determine the feasibility of special plantings. Only the trees and shrubs that can withstand the wetness and flooding are suitable. Some trees become established naturally. Once the trees are established, the additional moisture is beneficial.

This soil is suited to habitat for wetland, woodland, openland, and rangeland wildlife. The potential is fair for grasses and legumes, wild herbaceous plants, hardwood trees, coniferous plants, and shrubs. It is poor for grain and seed crops. The species selected for planting should be those that are tolerant of wetness and flooding. Some hardwood trees grow in all areas of this soil, except for the stream channels. Woodland wildlife, such as tree squirrels, cottontail rabbits, raccoons, and white-tailed deer, use the habitat for escape and shelter. Wetland wildlife, such as ducks, use the water in the streams. Hunting and fishing are the main recreation uses.

Because of the flooding and the seasonal wetness, this soil is generally unsuitable as a site for septic tank absorption fields or dwellings. A suitable alternative site is needed. Diking helps to protect sewage lagoons from flooding. Constructing the lagoon on fill material raises the bottom of the lagoon a sufficient distance above the seasonal high water table. Constructing local roads on suitable, well compacted fill material and providing adequate side ditches and culverts help to prevent the damage caused by flooding and wetness. Excessive damage caused by frost action can be prevented by a surface drainage system and by a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

This soil is assigned to capability unit Vw-7, dryland; pasture and hayland suitability group C-1; Subirrigated range site; and windbreak suitability group 10.

Ma—Massie silty clay loam, 0 to 1 percent slopes. This deep, nearly level, very poorly drained claypan soil is in the lowest, wettest parts of upland depressions. It is ponded for very long periods. It formed in loess. Areas are somewhat oblong or oval and range from 5 to about 420 acres in size.

Typically, a layer of partially decayed leaves and stems is on the surface. The surface layer is dark gray, friable silty clay loam about 6 inches thick. The subsurface layer is light gray, very friable silt loam about 2 inches thick. The subsoil extends to a depth of about 60 inches. The upper part is gray, very firm silty clay loam. The next part is gray, very firm silty clay. The lower part is light brownish gray, very firm silty clay and pale olive, firm silty clay loam. In some parts of the depressions, the surface layer has more silt or more clay, depending on the source and type of deposition. In some areas the soil does not have a subsurface layer

and is silty clay in the upper part of the subsoil. In other areas it has a buried surface layer.

Included with this soil in mapping are small areas of Fillmore and Scott soils and small areas of open water. Ponded water on the Fillmore and Scott soils is shallower than that on this Massie soil and is on the surface for a shorter period. These soils are slightly higher in the depressions than this Massie soil and do not have a layer of partially decayed leaves and stems on the surface. Included areas make up as much as 10 percent of this unit.

Permeability is very slow in the subsoil of this Massie soil. Available water capacity is high, but moisture is released slowly to plants. The soil is ponded for long periods from March through August. In wet years it has a perched seasonal high water table that ranges from 2 feet above the surface to 1 foot below sometimes throughout the year but mainly from March through July. The shrink-swell potential is moderate in the surface layer and subsurface layer and high in the subsoil. Organic matter content is high, and natural fertility is medium.

This soil supports wetland plants. Most of the acreage is used as wildlife habitat. Because of the water on the surface, the soil is unsuited to dryland and irrigated farming, pasture and hay, range, and windbreaks. It is suited to habitat for wetland wildlife. The potential is very poor for grain and seed crops, grasses and legumes, and wild herbaceous plants. The higher adjacent areas can provide these habitat elements. The potential for wetland plants is good, and the main plants are sedges, rushes, cattails, perennial smartweed, arrowhead, pondweed, and reed canarygrass. Waterfowl, such as geese and ducks, are the primary wildlife species on this habitat. Openland wildlife, such as pheasants, occasionally use the habitat for shelter during dry periods and when the ponded water is frozen. Hunting is the main recreation use. Although the potential for shallow water areas is good, dry summers or falls help to cause dry basins, which waterfowl bypass.

Because of the ponding, this soil is generally unsuitable as a site for dwellings and onsite waste disposal facilities. A suitable alternative site is needed. Constructing local roads on suitable, well compacted fill material above the ponding level and providing adequate side ditches and culverts help to prevent the damage caused by ponding. The roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarse grained base material helps to ensure better performance. Excessive damage caused by frost action can be prevented by a surface drainage system and by a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

This soil is assigned to capability unit VIIIw-7, dryland; pasture suitability group H; and windbreak suitability group 10. It is not assigned to a range site.

Mu—Muir silt loam, 0 to 1 percent slopes. This deep, nearly level, well drained soil is on rarely flooded terraces along perennial and intermittent streams. It formed in silty alluvium. Areas mostly are long, broad, and somewhat oblong and range from 5 to about 400 acres in size.

Typically, the surface layer is grayish brown, very friable silt loam about 7 inches thick. The subsurface layer is dark grayish brown, very friable silt loam about 8 inches thick. The subsoil is about 21 inches thick. It is friable. The upper part is dark grayish brown silty clay loam, and the lower part is grayish brown silt loam. The underlying material is stratified grayish brown and light gray loam about 12 inches thick. A buried surface layer is between depths of 48 and 60 inches. It is stratified dark grayish brown and gray silt loam. In few small areas, the soil is dark to a depth of less than 20 inches and and has a surface layer of fine sandy loam or silty clay loam. Some small areas are underlain by sandy material at a depth of more than 40 inches.

Included with this soil in mapping are small areas of Butler soils. Also included are small areas of soils on short, steep slopes on the sides of drainageways that cross the terraces. Butler soils are in the same positions on the landscape as this Muir soil but are not so well drained and have more clay in the subsoil. Included soils make up as much as 10 percent of this unit.

Permeability and the water intake rate for irrigation are moderate in this Muir soil. Available water capacity is high, and moisture is released readily to plants. Runoff is slow. Organic matter content is moderate, and natural fertility is high. Tilth is good. The shrink-swell potential is low.

Most of the acreage is farmed. The rest is mainly grassland used for pasture, hay, or range. The farmed areas are mostly irrigated, but some are used for dryland crops.

If used for dryland farming, this soil is suited to small grain, corn, grain sorghum, soybeans, and grasses and legumes. Where this soil is used for cultivated crops, conserving soil moisture and controlling soil blowing are the main management concerns. Conservation tillage practices, such as till planting and disking, that leave crop residue on the surface conserve moisture and help to prevent excessive soil blowing. Crop stubble left standing in winter traps snow, thus providing additional moisture. Returning crop residue and green manure crops to the soil and applying feedlot manure increase the organic matter content and improve tilth, water infiltration, and fertility.

If irrigated, this soil is suited to corn, grain sorghum, soybeans, and grasses and legumes. The adjacent streams and steep upland soils commonly limit the area

available for a center-pivot irrigation system. Using an application rate suited to the moderate water intake rate of this soil helps to control runoff of irrigation water. If a gravity system is used, a tailwater recovery system is needed to conserve irrigation water and improve the efficiency of water application.

This soil is suited to pasture and hay, which can be rotated with other crops. A cover of introduced grasses, generally bromegrass or orchardgrass or a mixture of one of those and alfalfa, is effective in controlling soil blowing. Overgrazing reduces the extent of the protective plant cover and lowers the quality of the plants. Proper stocking rates, rotation grazing, and timely applications of nitrogen fertilizer help to keep the plants and the soil in good condition.

This soil is suited to range and to native hay. The native plant community is mostly mid and tall grasses dominated by big bluestem, little bluestem, sideoats grama, and switchgrass. When the plants are overgrazed or improperly harvested for hay, some areas are dominated by Kentucky bluegrass, tall dropseed, and many annual and perennial weeds. Also, woody plants, such as snowberry and buckbrush, invade the site. Brush management and controlled burning are needed in some areas to remove the woody plants. Deferred grazing helps to maintain or improve the extent of the native grasses.

This soil is suited to trees grown as windbreaks. Seedlings generally survive and grow well if competing vegetation is removed by good site preparation and timely control measures. Some seedlings require watering during dry periods.

The rare flooding is the main hazard if this soil is used as a site for sanitary facilities and buildings. Diking helps to protect sewage lagoons from flooding. Lining or sealing the lagoon helps to prevent seepage. Constructing buildings and local roads on suitable, well compacted fill material above flood levels provides protection from flooding. Providing adequate side ditches and culverts also helps to protect the roads from flood damage. The roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to ensure better performance.

This soil is assigned to capability units I-1, dryland, and I-6, irrigated; pasture and hayland suitability group A-1; Silty Lowland range site; and windbreak suitability group 1.

MuB—Muir silt loam, 1 to 3 percent slopes. This deep, very gently sloping, well drained soil mainly is on colluvial foot slopes between upland breaks and nearly level stream terraces. In a few areas it is on the sides of shallow drainageways that cross the stream terraces. The soil formed in silty alluvium. It is subject to rare flooding. Areas are narrow and irregular in shape and range from 5 to about 40 acres in size.

Typically, the surface layer is about 10 inches thick. It is gray, very friable silt loam and dark grayish brown, very friable silty clay loam. The subsoil is silty clay loam about 41 inches thick. The upper part is grayish brown and very friable, and the lower part is brown and grayish brown and is friable. The underlying material to a depth of about 60 inches is pale brown silt loam. In a few small areas the soil is dark to a depth of less than 20 inches. In some areas the surface layer is less than 10 inches thick. In other areas it is fine sandy loam or loam.

Included in this soil in mapping are small areas of soils with slopes of more than 3 percent and a few small areas of sand and gravel. The soils with slopes of more than 3 percent are on the sides of drainageways that cross the foot slopes. The sand and gravel have been washed from the higher lying areas. Included areas make up as much as 15 percent of this unit.

Permeability and the water intake rate for irrigation are moderate in this Muir soil. Moisture is released readily to plants, and available water capacity is high. Organic matter content is moderate, and natural fertility is high. Tilth is good. The shrink-swell potential is low.

Most of the acreage is farmed. The rest is mainly native grassland used for pasture, hay, or range. The farmed areas are used mostly for dryland crops, but some are irrigated.

If used for dryland farming, this soil is suited to small grain, grain sorghum, soybeans, corn, and grasses and legumes. If the soil is used for cultivated crops, water erosion is a hazard. It can be controlled by terraces, contour farming, and grassed waterways. After heavy rains, water from the higher adjacent slopes sometimes causes rilling. As a result, diversions are needed. Applying conservation tillage practices, such as till planting and disking, that leave crop residue on the surface and leaving crop stubble standing throughout winter help to prevent excessive loss of soil and moisture. Returning crop residue and green manure crops to the soil and applying feedlot manure increase the organic matter content and improve tilth, water infiltration, and fertility.

If irrigated, this soil is suited to corn, grain sorghum, soybeans, and grasses and legumes. If a gravity system of irrigation is used, contour bench leveling is needed to control water erosion and a tailwater recovery system is needed to conserve irrigation water and improve the efficiency of water application. Using an application rate suited to the moderate water intake rate of this soil conserves irrigation water. The adjacent streams and steep uplands commonly limit use of a center-pivot irrigation system.

This soil is suited to pasture and hay, which can be rotated with other crops. Introduced grasses, generally bromegrass or orchardgrass or a mixture of one of those with alfalfa, are suitable. A cover of these plants is

effective in preventing excessive soil blowing. Overgrazing reduces the extent of the protective plant cover and lowers the quality of the plants. Proper stocking rates, rotation grazing, and timely applications of nitrogen fertilizer help keep the plants in good condition.

This soil is suited to range and to native hay. The native plant community is mostly mid and tall grasses dominated by big bluestem, little bluestem, sideoats grama, and switchgrass. When the plants are overgrazed or improperly harvested for hay, some areas are dominated by Kentucky bluegrass, tall dropseed, and many annual and perennial weeds. Also, woody plants, such as snowberry and buckbrush, invade the site. Brush management and controlled burning are needed in some areas to remove the woody plants. Deferred grazing helps to maintain or improve the extent of the native grasses.

This soil is suited to the trees grown as windbreaks. Seedlings generally survive and grow well if competing vegetation is removed by good site preparation and timely control measures. Where feasible, planting the trees on the contour can help to control water erosion. Some seedlings require watering during dry periods.

The rare flooding is the main hazard if this soil is used as a site for sanitary facilities and buildings. On sites for sewage lagoons, some grading is needed to modify the slope and shape the lagoon and diking protects the lagoon from flooding. Lining or sealing the lagoon helps to prevent seepage. Constructing dwellings and local roads on suitable, well compacted fill material above flood levels provides protection from flooding. Providing adequate side ditches and culverts also helps to protect the roads from flood damage. The roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to ensure better performance.

This soil is assigned to capability units IIe-1, dryland, and IIe-6, irrigated; pasture and hayland suitability group A-1; Silty Lowland range site; and windbreak suitability group 1.

MuC—Muir silt loam, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is mostly on the sides of drainageways that cross stream terraces. In a few areas it is on colluvial foot slopes between upland breaks and nearly level stream terraces. The soil formed in silty alluvium. It is subject to rare flooding. Areas are narrow and irregular in shape and range from 5 to about 25 acres in size.

Typically, the surface layer is dark grayish brown, very friable silt loam about 5 inches thick. The subsoil is very friable silty clay loam about 19 inches thick. The upper part is dark grayish brown, and the lower part is light brownish gray. The underlying material to a depth of about 60 inches is stratified grayish brown and light gray silt loam. In some areas the content of clay in the subsoil is more than 35 percent. In other areas the surface layer is fine sandy loam, loam, or silty clay loam.

Included in this soil in mapping are small areas of soils with slopes of more than 6 percent and a few small areas of sand and gravel. The soils with slopes of more than 6 percent are on the sides of drainageways that cross the foot slopes. The sand and gravel have been washed from the higher lying areas. Included areas make up as much as 15 percent of this unit.

Permeability and the water intake rate for irrigation are moderate in this Muir soil. Moisture is released readily to plants, and available water capacity is high. Organic matter content is moderate, and natural fertility is high. Tilth is good. The shrink-swell potential is low.

Most of the acreage is farmed. The rest is mainly native grassland used for pasture, hay, or range. The farmed areas are used mostly for dryland crops, but a few are irrigated.

If used for dryland farming, this soil is suited to small grain, grain sorghum, and grasses and legumes. Water erosion is the main hazard. Water erosion and runoff can be controlled by terraces, contour farming, and grassed waterways. Conservation tillage practices that leave crop residue on the surface help to control water erosion and conserve moisture. Leaving crop stubble standing throughout winter traps blowing snow, thus providing additional soil moisture. A cropping system that includes close-growing crops, such as wheat, alfalfa, or grasses, provides additional erosion control. Returning crop residue and green manure crops to the soil and applying feedlot manure increase the organic matter content and improve fertility, tilth, and water infiltration.

If irrigated, this soil is suited to grasses and such legumes as alfalfa. If erosion is controlled, the soil is suited to irrigated corn, grain sorghum, and soybeans. The sprinkler system is the best method of irrigation on this soil, but the steep adjacent slopes commonly limit its use. In some of the less sloping areas irrigated by a gravity system, contour bench leveling helps to control runoff. Because of the slope, controlling runoff and erosion is difficult. If a center-pivot sprinkler system is used, grass-covered terraces help to intercept runoff and prevent excessive water erosion, especially in wheel tracks. The grass on the terraces helps to keep wheels from making deep furrows in the soil. Additional crop residue is available because of irrigation. Leaving the residue on the surface by applying conservation tillage practices, such as till planting, helps to control water erosion. The rate of water application should be suited to the moderate intake rate of this soil.

This soil is suited to pasture and hay, which can be rotated with other crops. Introduced grasses, generally bromegrass or orchardgrass or a mixture of one of those with alfalfa, are suitable. A cover of these plants is effective in preventing excessive soil blowing. Overgrazing reduces the extent of the protective plant

cover and lowers the quality of the plants. Proper stocking rates, rotation grazing, and timely applications of nitrogen fertilizer help to keep the plants in good condition.

This soil is suited to range and to native hay. The native plant community is mostly mid and tall grasses dominated by big bluestem, little bluestem, sideoats grama, and switchgrass. When the plants are overgrazed or improperly harvested for hay, some areas are dominated by Kentucky bluegrass, tall dropseed, and many annual and perennial weeds. Also, woody plants, such as snowberry and buckbrush, invade the site. Brush management and controlled burning are needed in some areas to remove the woody plants. Deferred grazing helps to maintain or improve the extent of the native grasses.

This soil is suited to the trees grown as windbreaks. Seedlings generally survive and grow well if competing vegetation is removed by good site preparation and timely control measures. Planting the rows of trees on the contour and using strips of sod or a cover crop between the rows reduce the erosion hazard. Some seedlings require watering during dry periods.

The rare flooding is the main hazard if this soil is used as a site for sanitary facilities and buildings. On sites for sewage lagoons, some grading is needed to modify the slope and shape the lagoon and diking helps to protect the lagoon from flooding. Lining or sealing the lagoon helps to prevent seepage. Constructing dwellings and local roads on suitable, well compacted fill material above flood levels provide protection from flooding. Providing adequate side ditches and culverts also helps to protect the roads from flood damage. The roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to ensure better performance.

This soil is assigned to capability units IIIe-1, dryland, and IIIe-6, irrigated; pasture and hayland suitability group A-1; Silty Lowland range site; and windbreak suitability group 1.

Ob—Olbut-Butler silt loams, 0 to 1 percent slopes. This map unit consists of deep, nearly level, somewhat poorly drained claypan soils mostly in plane and slightly concave areas on uplands. These soils formed in loess. The Olbut soil is mostly in slightly concave areas and shallow upland depressions. It is subject to ponding. The Butler soil is in plane and slightly concave areas on uplands. The areas of this unit are at least 1,000 acres in size. They are 55 to 70 percent Olbut soil and 10 to 35 percent Butler soil. The two soils occur as areas so intermingled that it was not practical to map them separately.

Typically, the Olbut soil has a surface layer of grayish brown, very friable silt loam about 7 inches thick. The subsoil is about 33 inches thick. It is dark gray, very firm silty clay in the upper part; dark gray and gray, very firm silty clay in the next part; and olive gray, firm silty clay loam in the lower part. The middle and lower parts are both calcareous and saline. The underlying material to a depth of about 60 inches is pale yellow, calcareous and saline silty clay loam. In some areas the surface layer is silty clay loam. In other areas the content of exchangeable sodium in the subsoil is less than 10 percent.

Typically, the Butler soil has a surface layer of gray, very friable silt loam about 10 inches thick. The subsoil is about 26 inches thick. It is very dark gray, very firm silty clay in the upper part; dark grayish brown, very firm silty clay in the next part; and grayish brown, firm, calcareous silty clay loam in the lower part. The underlying material to a depth of about 60 inches is light brownish gray and light gray, calcareous silty clay loam and silt loam. In some areas the surface layer is less than 6 inches thick.

Included with these soils in mapping are small areas where deep cuts have been made and small areas of Crete, Fillmore, Kezan, and Scott soils, none of which contain soluble salts. Crete soils are in the slightly higher areas. They do not have an abrupt boundary between the surface layer and subsoil and have dark brown layers in the subsoil. Fillmore and Scott soils are in the deeper depressions and are more poorly drained than the Olbut and Butler soils. They have a distinct, grayish subsurface layer. Kezan soils are stratified and are on bottom lands. In the areas of deep cuts, a clayey subsoil has been exposed by land leveling. Included areas make up as much as 15 percent of this unit.

Permeability is slow in the Olbut and Butler soils, and the water intake rate for irrigation is low in the claypan subsoil. Available water capacity is high in the Butler soil and moderate in the Olbut soil, but moisture is released slowly to plants. Runoff is slow on both soils. The Olbut soil is ponded briefly after heavy rains and has a perched seasonal high water table 0.5 foot above the surface to 3.0 feet below. The Butler soil has a perched seasonal high water table at a depth of 0.5 foot to 3.0 feet. Tilth is fair in the Olbut soil and good in the Butler soil. The Olbut soil contains a slight to moderate amount of salts. It is moderately low in organic matter content and low in natural fertility. The Butler soil is moderate in organic matter content and medium in natural fertility. In areas where the subsoil has been exposed by land leveling, organic matter content is low, tilth is poor, and the amount of available zinc is deficient. The shrink-swell potential is moderate in the surface layer of both soils and high in the subsoil.

Most of the acreage is farmed. Most areas are used for dryland farming, but some are irrigated. Some areas of grasses are used for pasture and hay or for range.

If used for dryland farming, these soils are poorly suited to grain sorghum, small grain, sudangrass, and deep-rooted legumes. Salinity and low fertility limit the growth of crops in most areas. Generally, there are four

ways to at least partly overcome the effects of salinity: (1) providing drainage, (2) neutralizing some of the salts by applying sulfur and gypsum, (3) reducing the evaporation rate, and (4) planting salt-resistant crops. Grain sorghum and small grain are moderately to highly tolerant of salts and also tolerate the slow release of moisture from the claypan subsoil. Small grain, such as wheat, matures before the weather becomes hot and dry. Conservation tillage practices, such as till planting, chiseling, and disking, that keep all or part of the crop residue on the surface help to reduce the evaporation rate. After heavy rains, water often ponds on these soils for a period ranging from a few hours to a few days, especially in the spring. The excess water delays tillage and sometimes retards crop growth. Puddling and compaction occur if the soils are tilled when wet. As the soils dry, they become hard and cannot be easily worked. Returning crop residue and green manure crops to the soils and applying feedlot manure improves tilth, water infiltration, and fertility, helps to prevent crusting and compaction, and temporarily helps to slow salt buildup. The slower rate of salt buildup allows less resistant crops to be established. Deep-rooted legumes, such as alfalfa, are more resistant to salts than plants with shallow roots. The deep-rooted plants also loosen compacted layers and the claypan subsoil, thereby improving water infiltration and fertility and tilth.

If irrigated, these soils are poorly suited to corn, grain sorghum, grasses, and deep-rooted legumes. The adverse effects of salinity on plants can be partly overcome by providing drainage and leaching, by using sulfur and gypsum to neutralize the salts, by controlling evaporation, and by planting salt-resistant crops. Selecting the correct time for irrigation and a suitable application rate also helps to overcome salinity. The water should have a low sodium content. An adequate drainage system and light, frequent applications lower the perched water table and increase the extent of leaching. If a gravity or sprinkler system is used, land leveling improves surface drainage and helps to achieve a uniform distribution of water. Deep cuts expose the clayey subsoil, making tillage and seedling establishment difficult. Seedlings are especially sensitive to salts. Irrigating after planting increases the suitability of the soils for seedlings by moving some of the salts downward in the soil. Using a water application rate suited to the low water intake rate of the soils helps to control runoff of irrigation water. For example, applying water often and in long runs helps to prevent excessive runoff. A tailwater recovery system conserves water and improves the efficiency of water application. Adding a large amount of organic matter diminishes the effect of the salts on the crop and improves fertility, tilth, and water infiltration. The content of organic matter can be increased by using feedlot manure, crop residue, and green manure crops.

These soils are fairly suited to pasture and hay, which can be rotated with other crops. A cover of salt-tolerant introduced grasses, generally tall wheatgrass and switchgrass, is effective in controlling soil blowing. Overgrazing reduces the extent of the protective plant cover. Grazing when the soil is too wet compacts the surface layer, slows water infiltration, and injures the crowns of the plants. Proper stocking rates, rotation grazing, timely applications of nitrogen fertilizer, and restricted grazing during wet periods keep the pasture and the soil in good condition.

These soils are suited to range and to native hay. The native plant community is mostly short and mid grasses dominated by alkali sacaton, blue grama, inland saltgrass, slender wheatgrass, and western wheatgrass. When the plants are overgrazed, some areas are dominated by blue grama, inland saltgrass, western wheatgrass, and annual and perennial weeds. Restricted grazing during wet periods keeps the range in good condition.

These soils are fairly suited to some plantings for recreation areas and wildlife habitat. Only the trees and shrubs that can withstand moderate amounts of salts and occasional wetness are suited. Tilling and planting when the soils are moist but not wet can help to prevent crusting. Because of the high shrink-swell potential, cracks form in the soils during dry periods, allowing air to dry out the roots of shallow-rooted plants. Light cultivation after heavy rains reduces the extent of cracks at the surface, but supplemental water is needed to keep the subsoil from cracking or to close existing cracks. Established trees, such as the cottonwoods between the towns of Fairmont and Exeter, grow well because the roots have reached a perched seasonal high table that is at a depth of more than 60 inches.

Because of the slow permeability, the wetness, and the ponding, these soils are generally unsuitable as sites for septic tank absorption fields. Because of the ponding, they generally are unsuitable as sites for sewage lagoons or dwellings. A suitable alternative site is needed for sanitary facilities and dwellings. Constructing local roads on suitable, well compacted fill material above the ponding level and providing adequate side ditches and culverts help to prevent the damage caused by ponding and the perched seasonal high water table. The roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soils. Providing coarser grained base material helps to ensure better performance. Excessive damage caused by frost action can be prevented by providing good surface drainage and by installing a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

These soils are assigned to capability units IIIs-1, dryland, and IIIs-2, irrigated; pasture and hayland

suitability group G-1; Saline Lowland and Clayey range sites; and windbreak suitability groups 9S and 2W.

Pt—Pits, gravel. This map unit consists of excavations from which sand and gravel have been removed. Some of these pits are inactive. The unit is mainly on the breaks to or on the bottom lands along the West Fork of the Big Blue River, Elk Run, and Turkey Creek. The areas on the breaks are shallow to gravelly and sandy outwash. The areas on the bottom lands are deep to sandy and gravelly alluvium. Areas of the unit range from 5 to about 100 acres in size.

In most areas the material removed from these excavations is in steep piles adjacent to the pits. The nonsandy material can be smoothed and planted to native grasses, such as big bluestem, little bluestem, indiangrass, switchgrass, and sideoats grama. The sandy material is suited to other native grasses, such as sand reedgrass, sand lovegrass, and sand bluestem. After the plants have become established, these areas are suitable for range and wildlife habitat. Water areas are common in open pits. Cottonwood and willow trees are common along the edge of the water and invade some of the areas on bottom land. Soil blowing and water erosion are the main hazards in recent excavations.

This unit is assigned to capability unit VIIIs-8 and windbreak suitability group 10. It is not assigned to a pasture and hayland suitability group or to a range site.

Sc—Scott silt loam, 0 to 1 percent slopes. This deep, nearly level, very poorly drained claypan soil is in the lower parts of depressions on uplands. It formed in loess. It is ponded for long or very long periods. Areas mainly are somewhat oval or circular and range from 5 to about 200 acres in size. Some areas form a ring around lower, wetter soils.

Typically, the surface layer is dark grayish brown, very friable silt loam about 3 inches thick. The subsurface layer is light gray, very friable silt loam about 2 inches thick. The subsoil extends to a depth of about 60 inches. It is dark gray, very firm silty clay in the upper part; gray and grayish brown, very firm silty clay in the next part; and grayish brown and light brownish gray, firm silty clay loam in the lower part. In some areas soil blowing has mixed the surface layer with the subsurface layer. In some cultivated areas tillage has mixed the subsurface layer with part of the subsoil.

Included with this soil in mapping are small areas of Fillmore and Massie soils, small areas of Scott soils that have been drained, and small intermittent lakes. Fillmore soils are in the shallower parts of depressions and are better drained than this Scott soil. Also, their surface soil is thicker. The ponded water on Massie soils is deeper than that on this Scott soil and is on the surface for a longer period. Massie soils are in the lowest, wettest part of depressions and have partially decayed wetland plants on the surface. The drained Scott soils have been filled by land leveling and have been ditched or tiled. The intermittent lakes are void of most vegetation. A few have a distinct shoreline because of the wave action caused by winds. Included areas make up as much as 10 percent of this unit.

Permeability is very slow in the claypan subsoil of this Scott soil. Available water capacity is high, but moisture is released slowly to plants. Runoff is ponded for long periods from March through August. A perched seasonal high water table is 0.5 foot above the surface to 1 foot below, mainly from March through August. The shrink-swell potential is moderate in the surface layer and subsurface layer and high in the subsoil. Organic matter content is moderate, and natural fertility is medium. Tilth is fair.

Nearly two-thirds of the acreage supports wetland plants and grasses and is used for wildlife habitat or for limited grazing. The remaining areas are cultivated.

This soil generally is poorly suited to dryland farming. The principal limitation is ponding after heavy rains. In some dry years the soil is suitable for grain sorghum, but in most years crops are damaged by the ponding. After heavy rains, runoff from adjacent areas saturates the surface layer. Because natural outlets are not available, ponding takes place for several weeks or months until the water evaporates or is absorbed by the soil. This soil is difficult to cultivate because it is subject to ponding and because the clayey subsoil is commonly mixed with the surface layer. Because of the ponding, the soil is unsuitable for irrigation.

This soil is fairly suited to pasture. The main pasture plants are introduced grasses, generally reed canarygrass or a mixture of reed canarygrass and birdsfoot trefoil. Ponding limits the extent of the grasses. If the pasture is grazed when it is too wet, trampling by livestock results in the formation of small mounds. Overgrazing reduces the extent of the already thin plant cover. As a result, the soil is highly susceptible to soil blowing during dry periods. Proper stocking rates and restricted grazing during wet periods help to keep the grasses and the soil in good condition. Dug-out reservoirs provide water for livestock and for recreation uses. The amount of refill depends on the amount of water supplied by precipitation or by the irrigation water that runs off the higher adjacent areas.

This soil generally is not suited to range or windbreaks. Onsite investigation is needed to determine the feasibility of special plantings. Only the trees and shrubs that can withstand long periods of ponding are suitable for planting. Some trees become established by natural means near the boundaries of this soil.

This soil is suitable as habitat for wetland wildlife. The potential is poor for grain and seed crops and fair for grasses and legumes and wild herbaceous plants. The higher adjacent areas can provide these habitat elements. The potential for wetland plants is good. The main types of wetland plants are perennial forbs, such

as ironweed and smartweed; perennial grasses, such as Canada wildrye and barnyardgrass; annual forbs, such as ragweed; and sedges. Waterfowl, mainly geese and ducks, are the primary species on this habitat. Openland wildlife, such as pheasants, use the habitat for shelter during dry periods and when the ponded water is frozen. Hunting is the main recreation use but is sometimes limited. Although the potential for shallow water areas is good, dry summers and falls help to cause dry basins, which waterfowl bypass.

Because of the ponding, this soil is generally unsuitable as a site for dwellings and onsite waste disposal. A suitable alternative site is needed. Constructing local roads on suitable, well compacted fill material above the ponding level and providing adequate side ditches and culverts help to prevent the damage caused by ponding. The roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarse grained base material helps to ensure better performance. Excessive damage caused by frost action can be prevented by providing good surface drainage and by installing a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

This soil is assigned to capability unit IVw-2, dryland; pasture and hayland suitability group C-2; and windbreak suitability group 10. It is not assigned to a range site.

Sd—Scott silty clay loam, drained, 0 to 1 percent slopes. This deep, nearly level, poorly drained claypan soil is in depressions and basins on uplands. It formed in loess. It originally was a very poorly drained soil but has been leveled and ditched or tile drained. In a few areas large dugouts have been built to trap water. Areas are somewhat oval or circular and range from about 40 to 300 acres in size.

Typically, the surface layer is mixed gray and light gray, firm silty clay loam about 5 inches thick. The subsoil extends to a depth of 60 inches or more. It is gray, firm silty clay loam in the upper part; gray, very firm silty clay in the next part; and grayish brown and light brownish gray, firm silty clay loam in the lower part. In places the surface layer is more friable, is thicker, and is silt loam. In a few places the soil has a subsurface layer of light gray silt loam. In most places the subsurface layer has been mixed with the surface layer and the upper part of the subsoil by tillage and land leveling.

Included with this soil in mapping are small areas of Butler soils and undrained Scott soils. Butler soils are in the slightly higher parts of the depressions or basins. The undrained Scott soils are very poorly drained and are in the lower parts of the depressions. Included soils make up as much as 10 percent of this unit.

Permeability is very slow in this Scott soil. The water intake rate for irrigation is very low. Available water capacity is high, but moisture is released slowly to plants. Runoff is slow. After heavy rains the surface layer is saturated for long periods. A perched seasonal high water table is at a depth of 0.5 foot to 2.0 feet, mainly from March through August. The shrink-swell potential is high in the surface layer and subsoil. Tilth is poor. Organic matter content is moderate, and natural fertility is medium.

Nearly all the acreage is farmed. Some areas are irrigated. A few areas of grasses are used for grazing or wildlife habitat.

If used for dryland farming, this soil is poorly suited to grain sorghum and small grain. In wet years ditches, tile drains, or dugouts do not remove the ponded water fast enough to keep it from damaging crops. Even in drier years, planting, tillage, and harvesting often are delayed by wetness. This soil is difficult to work because of the texture of the surface layer. Conservation tillage practices, such as till planting, leave crop residue on the surface and thus improve tilth, help to prevent compaction, conserve moisture, and improve water infiltration.

If irrigated, this soil is poorly suited to corn and grain sorghum because of the wetness. A gravity or sprinkler system can be used. Using an application rate suited to the very low water intake rate of this soil helps to prevent excessive wetness. If a gravity system is used, a tailwater recovery system is needed. By softening the crust on the surface layer, a sprinkler system helps seedlings to emerge.

This soil is suited to pasture and hay. Introduced grasses, generally reed canarygrass or a mixture of reed canarygrass and birdsfoot trefoil, are suited. If the pasture is grazed when too wet, compaction and mounding are problems. Overgrazing reduces the extent of the protective plant cover and thus increases the susceptibility to soil blowing during dry years. Proper stocking rates and restricted grazing during wet periods help to keep the plants and the soil in good condition. Dug-out reservoirs provide water for livestock and recreation uses.

This soil is fairly suited to some of the trees grown as windbreaks. Only the trees and shrubs that can withstand the wetness are suited. Tillage and planting sometimes are delayed until the soil begins to dry out.

Because of the very slow permeability and the wetness, this soil is generally unsuitable as a site for dwellings and onsite waste disposal. A suitable alternative site is needed. Local roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to ensure better performance. Constructing the roads on suitable, well compacted fill material and providing adequate side ditches and culverts help to prevent the damage caused by wetness. Excessive damage caused by frost action can be

prevented by providing good surface drainage and by installing a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

This soil is assigned to capability units IIIw-2, dryland, and IIIw-1, irrigated; pasture and hayland suitability group C-2; Clayey Overflow range site; and windbreak suitability group 2W.

UyE2—Uly silt loam, 11 to 17 percent slopes, eroded. This deep, moderately steep, somewhat excessively drained soil is mostly on the short, steep sides of upland drainageways. In a few areas it is on the sides of drainageways crossing terraces. Rills and gullies are common. The soil formed in loess. Areas range from 5 to about 50 acres in size.

Typically, the surface layer is brown, very friable silt loam about 9 inches thick. In most areas erosion has removed the original dark surface layer and most of the subsoil. The subsoil is very pale brown, very friable silt loam about 6 inches thick. The underlying material to a depth of about 60 inches is very pale brown, calcareous silt loam. In some areas the surface layer is silty clay loam. In other areas it is calcareous.

Included with this soil in mapping are small areas of eroded Geary soils, eroded Hastings soils, and Hobbs soils. Geary soils are on the short, moderately steep sides of drainageways, are lower on the landscape than this Uly soil, have more clay in the subsoil, and have reddish layers. Hastings soils are less sloping than this Uly soil and have more clay in the subsoil. Hobbs soils are stratified and are on the narrow bottoms of drainageways. Included soils make up as much as 15 percent of this unit.

Permeability is moderate in this Uly soil. Available water capacity is high, and moisture is released readily to plants. Runoff is rapid. Tilth is poor. Organic matter content is low, and natural fertility is medium. The shrink-swell potential is low.

Nearly all of the acreage is farmed. A few areas have been reseeded to native or introduced grasses and are used for grazing or hay.

This soil is unsuited to dryland or irrigated farming because of the slope and the water erosion hazard. Reseeding cultivated areas to grass helps to control erosion.

This soil is suited to pasture and hay. A cover of introduced grasses, generally bromegrass or a mixture of bromegrass and alfalfa, greatly reduces the hazard of water erosion. Overgrazing reduces the extent of the protective plant cover, lowers the quality of the plants, and increases the hazards of runoff and erosion. Proper stocking rates, rotation grazing, and timely applications of nitrogen and phosphorus fertilizer keep the pasture and the soil in good condition.

This soil is suited to range. A cover of range plants is very effective in controlling water erosion. The native plant community is mostly mid and tall grasses dominated by big bluestem, indiangrass, little bluestem, porcupinegrass, sideoats grama, and switchgrass. When the plants are overgrazed or improperly harvested for hay, big bluestem, little bluestem, indiangrass, and switchgrass decrease in abundance and sideoats grama, tall dropseed, Kentucky bluegrass, and annual and perennial weeds increase. If overgrazing continues for many years, the abundance of the less desirable plants, especially Kentucky bluegrass, buckbrush, snowberry, and sumac, increases. The correct placement of fences and watering and salting facilities can ensure the proper distribution of livestock. Installing earth dams and excavated ponds helps to provide water for livestock, irrigation, and recreation uses and helps to control runoff. Applying conservation land treatment measures near those structures helps to prevent sedimentation.

This soil is suited to the trees grown as windbreaks. If competing vegetation is removed by good site preparation and timely control measures, the seedlings generally survive, but the growth rate is slower than that on some less sloping soils. Planting the rows of trees on the contour, terracing, and planting a cover crop between the rows reduce the water erosion hazard. Some seedlings require supplemental water during dry periods.

Because of the slope, this soil is generally unsuitable as a site for sewage lagoons. The slope is the main limitation on sites for septic tank absorption fields, dwellings, and local roads. On sites for septic tank absorption fields, land shaping and installing the absorption field on the contour help to ensure proper performance. Dwellings should be designed so that they conform to the slope of the land, or the site should be graded. Cuts and fills are generally needed to provide a suitable grade for local roads. The roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to ensure better performance.

This soil is assigned to capability unit VIe-8, dryland; pasture and hayland group A-3; Silty range site; and windbreak suitability group 3.

UyF—Uly-Hobbs silt loams, 0 to 30 percent slopes. This map unit consists of a deep, moderately steep and steep, somewhat excessively drained Uly soil on uplands and a deep, nearly level, well drained Hobbs soil on bottom lands. The Uly soil is mostly on side slopes along upland drainageways. In a few areas it is on the side slopes of drainageways crossing terraces. The side slopes are short and smooth or catstepped. The Uly soil formed in loess. The Hobbs soil is at the bottoms of narrow, channeled drainageways. It formed in stratified, silty alluvium and is occasionally flooded. Areas are 40

to 70 percent Uly soil and 30 to 50 percent Hobbs soil. The areas of the two soils are so long and narrow that it was not practical to map them separately.

Typically, the Uly soil has a surface layer of grayish brown, very friable silt loam about 6 inches thick. The subsoil is about 14 inches thick. It is friable. It is dark grayish brown silt loam in the upper part, pale brown silty clay loam in the next part, and very pale brown silt loam in the lower part. The underlying material to a depth of about 60 inches is pale yellow, calcareous silt loam. In some areas the surface layer is less than 6 inches thick. The subsoil in some areas is more than 30 percent clay. The subsoil is exposed in some small eroded areas that have been overgrazed or cultivated and on catsteps where the soil is eroded.

Typically, the Hobbs soil has a surface layer of stratified pale brown and grayish brown, friable silt loam about 17 inches thick. The underlying material to a depth of about 60 inches is stratified grayish brown, brown, and dark brown silty clay loam. In some areas the surface layer is silty clay loam.

Included with these soils in mapping are small areas of Geary and Muir soils. Geary soils are on the short, steep sides of drainageways and are lower on the landscape than this Uly soil. They have more clay in the subsoil than the Uly or Hobbs soil and have reddish or pinkish layers. Muir soils have less clay in the subsoil than the Uly or Hobbs soil and are on foot slopes. Included soils make up as much as 20 percent of this unit.

Permeability is moderate in the Uly and Hobbs soils. Available water capacity is high, and moisture is released readily to plants. Runoff is rapid on the Uly soil and slow on the Hobbs soil. Tilth is good in both soils. Organic matter content is moderately low in the Uly soil and moderate in the Hobbs soil. Both soils are high in natural fertility. The shrink-swell potential is low.

Nearly all of the acreage supports native grasses used for grazing or hay. A few areas are farmed or are used for pasture and hay.

These soils are unsuited to dryland and irrigated farming because of the slope and a very severe erosion hazard. Reseeding the cultivated areas helps to control erosion. A few of the less sloping areas of the Uly soil and most areas of the Hobbs soil are suited to pasture and hay.

These soils are suited to range. A cover of range plants is very effective in controlling water erosion (fig. 11). The native plant community is mostly mid and tall

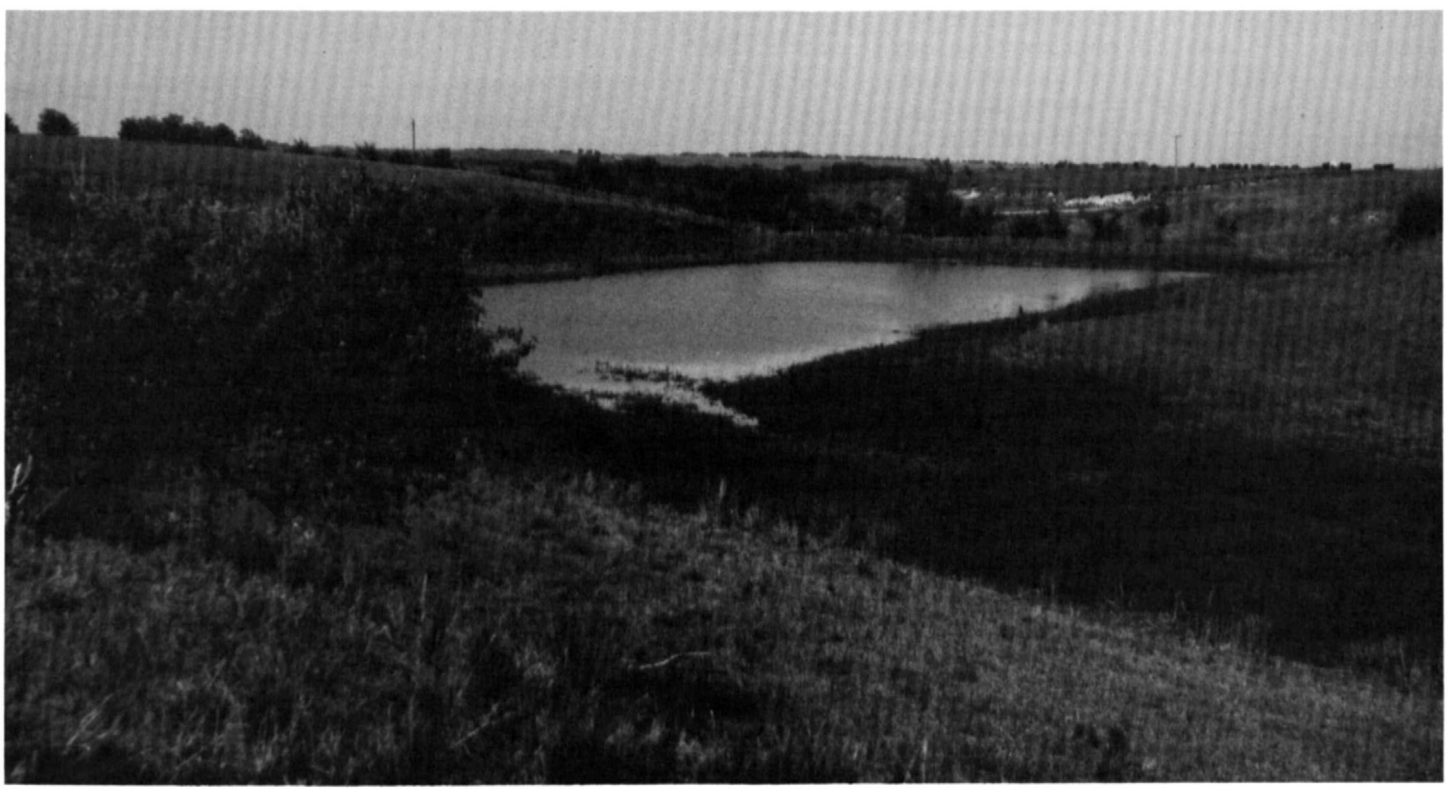


Figure 11.—Native grasses and the reservoir help to control runoff and erosion in the area of Uly-Hobbs silt loams, 0 to 30 percent slopes, used as range.

grasses. The Uly soil is dominated by big bluestem, indiangrass, little bluestem, porcupinegrass, sideoats grama, and switchgrass. When the plants are overgrazed or improperly harvested for hay, big bluestem, little bluestem, indiangrass, and switchgrass decrease in abundance and sideoats grama, tall dropseed, Kentucky bluegrass, and annual and perennial weeds increase. If overgrazing continues for many years on the Hobbs soil, the abundance of the less desirable plants, especially Kentucky bluegrass, buckbrush, snowberry, and sumac increases. The Hobbs soil is dominated by big bluestem, little bluestem, switchgrass, and various sedges. When the plants are overgrazed or improperly harvested for hay, some areas of this soil are dominated by Kentucky bluegrass, sedges, and many annual and perennial weeds. Also, woody plants, including snowberry and buckbrush, invade the site. The correct placement of fences and watering and salting facilities can ensure the proper distribution of livestock. In some areas reseeding or interseeding is needed because the native plant community has been deteriorating for many years. Occasional flooding in areas of the Hobbs soil on the narrow bottom land causes sedimentation and the introduction of weeds. Controlling weeds and brush allows the desirable grasses to reseed. Installing earth dams and excavated ponds helps to provide water for livestock, irrigation, and recreation uses and helps to control runoff. Applying conservation land treatment measures near those structures helps to prevent sedimentation.

The Uly soil generally is poorly suited to the trees grown as windbreaks. Onsite investigation is needed to determine if trees and shrubs can be planted on specially prepared sites. The Hobbs soil is suited to windbreaks. Occasionally, flooding damages some new plantings. Once the trees are established, however, the additional moisture is beneficial. Control of competing grasses, weeds, and shrubs increases the survival rate of seedlings. Young trees should be protected from grazing by livestock.

These soils generally are unsuitable as sites for sanitary facilities because of the slope. A suitable alternative site is needed. If sewage lagoons are built on the Hobbs soil, dikes are needed to provide protection from flooding. The Hobbs soil is generally unsuitable as a building site because of the flooding. Dwellings on the Uly soil should be designed so that they conform to the natural slope of the land, or the site should be graded. Cuts and fills are generally needed to provide a suitable grade for local roads. The roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soils. Providing coarser grained base material helps to ensure better performance. Constructing the roads on suitable, well compacted fill material above flood levels and providing adequate side ditches and culverts help to prevent the damage caused by flooding on the Hobbs soil.

These soils are assigned to capability unit VIe-1, dryland; pasture and hayland suitability groups H-1 and A-1; Silty and Silty Overflow range sites; and windbreak suitability groups 10 and 1.

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland; for windbreaks; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

The soils in the survey area are assigned to various interpretive groups at the end of each map unit description and in some of the tables. The groups for each map unit also are shown in the section "Interpretive Groups," which follows the tables at the back of this survey.

Crops and Pasture

Prepared by William E. Reinsch, conservation agronomist, Soil Conservation Service.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

In 1983, about 89 percent of the acreage in farms in Fillmore County was used for crops. The largest acreage is used for corn, followed in extent by sorghum, soybeans, wheat, and alfalfa hay. About 55 percent of the cropland is irrigated.

If well managed, most of the soils in the county are well suited to cultivated crops. The Hastings and Crete soils make up most of the acreage used for crops.

Management for Dryland Crops

Good management for dryland crops reduces the runoff rate and the susceptibility to erosion, conserves moisture, and improves tilth. Most of the soils in Fillmore County are suitable for the production of crops. In many areas, however, the erosion hazard should be reduced by suitable conservation practices.

Water erosion is a major problem on some of the soils that are suitable for crops. Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced when the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging to soils that have a clayey subsoil, such as Geary and Hastings soils. Second, erosion can result in sedimentation in streams. Control of erosion minimizes this pollution and improves the quality of water for municipal and recreation uses and for fish and wildlife.

The overall hazard of erosion can be reduced if the more productive soils are used for row crops and the

steeper, more erodible soils are used for close-growing crops, such as wheat, rye, alfalfa, hay, and pasture. Good management can reduce the hazard of erosion in many areas. Erosion-control practices provide a protective plant cover, reduce the runoff rate, and increase the rate of water infiltration. A cropping sequence that keeps a plant cover on the surface for extended periods reduces the extent of erosion so that the productive capacity of the soil is not decreased. A plant cover on at least 20 percent of the surface reduces the hazard of erosion significantly.

Terraces, contour farming, grassed waterways, contour stripcropping, and conservation tillage help to control erosion in Fillmore County. No-till and till-plant systems for row-crop production reduce the erosion hazard in sloping areas used for row crops. These conservation tillage practices are suited to most soils in the survey area. Terraces and diversions reduce the length of slopes and thus also reduce the runoff rate and the susceptibility to erosion. They are most effective on deep, well drained soils that have uniform slopes. The gently sloping and moderately sloping Crete, Geary, and Hastings soils are suitable for terraces and contour farming. Contour farming improves the effectiveness of conservation tillage.

Soil blowing is a hazard on some of the soils in the county. The hazard on the silty soils is greatest when the surface is void of residue. Management practices similar to those that control water erosion can be used to control soil blowing. Stubble mulching, conservation tillage, crop residue management, and narrow field windbreaks are effective measures.

Cropland management should preserve tilth and fertility; maintain a plant cover that protects the soil from erosion; control weeds, insects, and diseases; and reduce the runoff rate. Management systems vary according to the soils on which they are used. For example, a management system for crops on Hastings silty clay loam, 6 to 11 percent slopes, eroded, should include a large proportion of grasses and legumes in the crop rotation, terraces, contour farming, and a tillage method that leaves a cover of crop residue on 40 percent of the surface after planting. In contrast, on Muir silt loam, 0 to 1 percent slopes, row crops can be grown year after year. Leaving crop residue on the field throughout winter, applying fertilizer, and applying other good management practices are sufficient to maintain the productive capacity of this soil.

In intensive cropping systems, crop residue is an asset to water conservation, maintenance of fertility, and erosion control. Standing crop stubble traps snow on the field and limits evaporation. Returning crop residue to the soil helps to maintain soil fertility and improves tilth for future crops. About 2 tons of crop residue per acre provides about 20 pounds of nitrogen, 10 pounds of available phosphate, and 30 pounds of potash. Mixing crop stubble into the soil reduces soil bulk density, helps to prevent surface crusting, and reduces fuel requirements for tillage. More importantly, the cover of crop residue helps to control erosion.

The main management practices on livestock farms are the inclusion of grasses and legumes in the crop rotation and the addition of manure, both of which improve fertility. These practices reduce the hazards of water erosion and soil blowing on short and irregular slopes, where contouring and terracing are not feasible. In addition, they supply plant nutrients to the soil and improve tilth. Leaving crop residue on the surface helps to control erosion.

Under dryland management, the kind and amount of fertilizer added to soils should be based on the results of soil tests and on the content of moisture in the soil at the time of application. For instance, if the subsoil is dry and rainfall is low, the rate at which fertilizer is applied should be slightly lower than the rate used if the subsoil moisture is adequate. For nonlegume crops, nitrogen is beneficial on all soils. Phosphorus and zinc are needed on the more eroded soils and in areas that were excavated during the construction of terraces or waterways.

Herbicides can be used to control weeds, but care should be taken to ensure that the kind of herbicide and the application rate used are suited to the soil conditions. The colloidal clay and humus in the soil are responsible for much of the chemical activity in the soil. Therefore, a heavy application rate of herbicides on soils that are low in content of colloidal clay or that have a moderately low or low organic matter content causes a hazard of crop damage.

Management of Irrigated Cropland

About 55 percent of the cropland in Fillmore County is irrigated. About three-fourths of the irrigated cropland is used for corn, and the rest is used for soybeans, sorghum, and alfalfa. A furrow or sprinkler system is suitable for corn, sorghum, and soybeans. Alfalfa can be irrigated by a border, contour ditch, corrugation, or sprinkler system. The irrigation water is drawn almost entirely from wells.

The cropping system on soils that are well suited to irrigation consists mostly of row crops. A cropping sequence that includes different row crops, small grain, and alfalfa or grasses helps to control the cycle of diseases and insects that are common if the same crop is grown year after year.

Soil can hold only a limited amount of water. As a result, irrigation water should be applied at regular intervals, so that the soil is moist at all times. The interval varies according to the crop and the time of year. The application rate should not exceed the water intake rate of the soil. A silt loam or silty clay loam in Fillmore County holds about 2 inches of available water per foot of soil depth. As a result, a soil that is 4 feet

deep and is planted to a crop that sends its roots to that depth can hold about 8 inches of available water for that crop. Maximum efficiency of furrow irrigation can be achieved if the irrigation process is started when about half of the stored water has been used by the plants. Thus, if a soil holds 8 inches of available water, irrigation should be started when 4 inches has been removed.

Irrigated soils generally produce higher yields than dryfarmed soils; consequently, more plant nutrients, particularly nitrogen and phosphorus, are removed when the crops are harvested. Mixing all crop residue into the soil and adding feedlot manure and commercial fertilizer help to maintain fertility. Most grain crops in Fillmore County respond to applications of nitrogen. Applications of phosphorus, zinc, and iron are effective if crops are grown on soils that have been disturbed by land leveling, particularly if the topsoil has been removed. The kinds and amounts of fertilizer needed for specific crops should be determined by soil tests.

Gently sloping soils, such as Hastings silt loam, 3 to 6 percent slopes, are subject to water erosion if irrigation furrows run down the slope. If furrow irrigation is used, these soils can be contour bench leveled, or the furrows can be established on the contour and parallel terraces can be used. Land leveling increases the efficiency of irrigation by allowing a more even distribution of water.

A tailwater recovery system increases the efficiency of the irrigation system and conserves water. One at the end of the furrow-irrigated field traps runoff from excess irrigation. This water then can be pumped to the upper end of the field and applied again.

Sprinkler systems can be used on the more sloping soils and on the nearly level ones. If a sprinkler irrigation system is used on such soils as Hastings silty clay loam, 3 to 6 percent slopes, eroded, and Geary silty clay loam, 6 to 11 percent slopes, eroded, the same conservation practices that are used to control water erosion on nonirrigated cropland are needed. These practices include terraces, contour farming, grassed waterways, and tillage methods that leave a protective cover of crop residue on the surface (fig. 12).

There are two general kinds of sprinkler systems: (1) sets that are placed in a location and operate there until a specified amount of water has been applied and (2) the center-pivot type, in which an array of sprinklers rotates around a central point. In either system, water

Figure 12.—Corn that was planted on the contour in an irrigated area of Crete silt loam, 0 to 1 percent slopes.

should be applied at a rate at which the soil can absorb it, thus eliminating runoff.

Because the application of water by sprinklers can be carefully controlled, sprinkler systems can be used for special conservation purposes, such as establishing a new pasture on a moderately steep soil. In summer, however, much of the water is lost through evaporation, and wind drift can cause uneven application in some sprinkler systems. Watering at night, when windspeed and temperature are lower, reduces the evaporation rate and improves water distribution.

Every soil suitable for irrigation in Nebraska is assigned to an irrigation design group (*8*). An Arabic number at the end of a capability unit assigned to an irrigated soil indicates the irrigation design group to which the soil belongs. Assistance in planning and designing irrigation systems is available from the local office of the Soil Conservation Service or the county agricultural agent. Estimates of the cost of equipment can be obtained from local dealers and manufactures of irrigation equipment.

Management of Pasture and Hayland

Most forage plants are a good source of minerals, vitamins, proteins, and other nutrients for cattle and sheep. A well managed pasture can provide a balanced ration throughout the growing season. Once the pasture has been established, the grasses should be kept productive. A planned grazing system that meets the needs of the plants and helps to achieve a uniform distribution of grazing is needed.

A mixture of grasses and legumes can be grown on many soils and is compatible with grain crops in a crop rotation. Because the grasses and legumes improve tilth, add organic matter, and reduce the hazard of erosion, they are ideal for use in a conservation cropping system.

Under a high level of management, irrigated pasture in Fillmore County can produce 750 to 900 pounds of beef per acre. Converting cropland to irrigated pasture helps to control erosion. The commonly grown grasses on an irrigated pasture are smooth brome and orchardgrass. Other grasses and legumes that are suitable for irrigation in the county are intermediate wheatgrass, meadow brome, and creeping foxtail.

Grasses that can be grown without irrigation are smooth brome, intermediate wheatgrass, meadow brome, and tall fescue. Some native, warm-season grasses, such as switchgrass, indiangrass, and big bluestem, can be planted as a single species on nonirrigated land to maintain forage quality during the grazing season. Legumes that can be grown on an irrigated or nonirrigated pasture are alfalfa, birdsfoot trefoil, and cicer milkvetch.

Whether irrigated or not, grasses and legumes grown for pasture and hay require additional plant nutrients to obtain maximum vigor and growth. The kinds and amounts of fertilizer needed should be determined by soil tests.

At the end of each map unit description, the soil has been assigned to a pasture and hayland suitability group. The assignment of a soil to one of these groups is based primarily on the suitability of the soil for certain pasture plant species and on the management needs and potential productivity of the soil. Detailed interpretations for each pasture suitability group in the county are provided in the Technical Guide, which is available in the local office of the Soil Conservation Service.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, feedlot manure, and green manure crops; and harvesting that ensures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-1 or IIIe-8.

The acreage of soils in each capability class and subclass is shown in table 6. The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in the yields table.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban and built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil economically to produce a sustained high yield of crops. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

A recent trend in land use in some parts of the county has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

About 317,655 acres in Fillmore County, or about 86 percent of the total acreage, meets the soil requirements

for prime farmland. The map units that are considered prime farmland are listed in table 7. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Some soils that have a seasonal high water table qualify for prime farmland only in areas where this limitation has been overcome by such drainage measures. The need for these measures is indicated after the map unit name in table 7. Onsite evaluation is needed to determine whether or not this limitation has been overcome by corrective measures.

Rangeland

Prepared by Peter N. Jensen, range conservationist, Soil Conservation Service.

Rangeland, which includes cropland reseeded to a mixture of native grasses, makes up about 8 percent of the agricultural land in Fillmore County, or about 31,500 acres. It is mainly along the drainageways and upland breaks near the major creeks and the West Fork of the Big Blue River, largely in the Hastings-Uly-Geary and Hastings-Crete-Geary associations, which are described under the heading "General Soil Map Units." Most of the rangeland in these associations is in the Silty and Clayey range sites (fig. 13). Some rangeland is in the Muir-Hobbs-Butler and Olbut-Butler associations. This rangeland is mainly in the Silty Lowland, Silty Overflow, and Saline Lowland range sites. The average livestock farm in the county is 320 acres in size.

Generally, livestock producers in Fillmore County raise small herds of cows and calves and sell the calves in the fall as feeders. The rangeland generally is grazed from late in spring through early in fall. The livestock graze smooth brome in spring, are fed corn stalks or stalks of grain sorghum (milo) in fall and early in winter, and are fed alfalfa hay or silage, or both, for the rest of the winter.

Much of the rangeland has been depleted by overgrazing. The overgrazed areas support low-vigor forage plants. Many of these areas have an abundance of pasture weeds and some shrubs. The productivity and condition of the range can be improved by proper grazing use, a planned grazing system, and brush and weed control.

Technical assistance in developing a forage management system, in reseeding cropland to native grasses or other grasses, in controlling weeds or brush, and in applying other aspects of a grassland program is available at the local office of the Soil Conservation Service.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 8 shows, for nearly every soil, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as rangeland or are suited to use as rangeland are listed. An explanation of the column headings in table 8 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre of air-dry vegetation. Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. Under *composition*, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more

Figure 13.—An area of Uly soils used as rangeland. The range site is Silty.

closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, control of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Windbreaks and Environmental Plantings

Prepared by Keith A. Ticknor, forester, Soil Conservation Service.

On most farmsteads in Fillmore County, trees have been planted at various times. Siberian elm and eastern redcedar were the most common species planted immediately after the farmsteads were established and are still in the older windbreaks. Large eastern cottonwoods are common on farmsteads, mainly in areas of the Olbut-Butler association, which is described under the heading "General Soil Map Units." Some of the other species that have been planted are silver maple, green ash, lilac, Russian mulberry, ponderosa pine, Rocky Mountain juniper, hackberry, Scotch pine, northern catalpa, black walnut, and Austrian pine.

Tree planting around the farmstead is a continuing need because old trees deteriorate, because some trees are destroyed by insects, disease, or storms, and because new windbreaks are needed on expanding farmsteads (fig. 14). Supplemental planting is needed to restore the effectiveness of many old windbreaks.

Nearly all of the field windbreaks occur as hedgerows of osageorange along farm and field boundaries. Most of the hedgerows are in the southeastern part of the county, and a very few are in the northwestern part. A few single-row field windbreaks of eastern cottonwood are mainly in areas of the Olbut-Butler association.

Figure 14.—A three-row windbreak of eastern redcedar in an area of Hastings silt loam, 1 to 3 percent slopes.

The growth, survival, and effectiveness of a windbreak depend on the suitability of the soil on the site for the trees or shrubs selected for planting. Permeability, available water capacity, fertility, soil texture, soil depth, and drainage greatly affect the growth rate of the trees and shrubs.

Trees and shrubs are easily established on most soils in Fillmore County. Competition from weeds and grasses is the cause of most windbreak failures; therefore, proper site preparation prior to planting and control of weeds and other competing vegetation after planting are the major concerns in establishing and managing a windbreak. Supplemental watering also is needed to establish newly planted trees and shrubs.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 9 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 9 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens.

At the end of each map unit description, the soil has been assigned to a windbreak suitability group. These groups are based primarily on suitability of the soil for the locally adapted species, as is indicated by their growth and vigor. Detailed interpretations for each windbreak suitability group in the county are provided in the Technical Guide, which is available in the local office of the Soil Conservation Service.

Additional information on planning windbreaks and screens and planting and caring for trees and shrubs

can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Native Woodland

Prepared by Keith A. Ticknor, forester, Soil Conservation Service.

Only a small part of Fillmore County is forested. The wooded areas occur as narrow bands along the major streams. Generally, the density of the woodland increases as the distance from the headwaters increases.

The species in the forested areas are mixed. In most areas no one species dominates. Eastern cottonwood, honeylocust, Russian mulberry, green ash, black willow, eastern redcedar, black walnut, boxelder, American plum, smooth sumac, bur oak, and silver maple are the most common species. Bur oak is mostly in the eastern third of the county, where it is dominant in a few areas.

Commercial use of the forested areas is limited by the very small amount of forested land. The soils on terraces and bottom lands along the major streams have good potential for Christmas trees and for the trees used for sawtimber, firewood, and other wood products, but these soils are used mostly as cropland and are unlikely to be converted to woodland.

Recreation

Prepared by Robert O. Koerner, biologist, Soil Conservation Service.

The U.S. Fish and Wildlife Service has designated seven waterfowl production areas in the county that provide opportunities for hunting. These areas also provide opportunities for bird watching, hiking, and photography.

The streams in the county are shallow and limited in recreation value. About 600 small farm ponds in the county make up more than 900 acres. Some of the deeper ponds are stocked with bass, bluegill, and channel catfish.

Technical assistance in designing recreation facilities is available at the office of the Soil Conservation Service in Geneva.

The soils of the survey area are rated in table 10 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 10, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 10 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 13 and interpretations for dwellings without basements and for local roads and streets in table 12.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife Habitat

Prepared by Robert O. Koerner, biologist, Soil Conservation Service.

The type and amount of wildlife habitat in Fillmore County vary according to the soil, the topography, the slope, and the drainage pattern. The paragraphs that follow describe the kinds of wildlife that inhabit the soil

associations described under the heading "General Soil Map Units."

The Hastings-Crete and Crete-Butler associations make up about 77 percent of the county. They consist mainly of openland inhabited by such wildlife as pheasant and bobwhite quail. Cropland is the major land use. The extent of nesting cover and winter cover is limited for upland game species, though farmstead windbreaks supply some winter cover. Scattered throughout these associations are many wetlands. Some of these wetlands hold water throughout the growing season. The majority, however, dry out and are farmed.

The wetlands allow migrating waterfowl and shorebirds to disperse over a large area, rather than being concentrated in the deeper, more permanent marshes and lagoons. This dispersion lessens the spread of Asian fowl colera, a contagious, usually fatal disease. The shallow wetland areas also are a source of worms and other invertebrates that provide protein for the birds. This protein is essential to the birds for migration and breeding.

The wildlife habitat in the Crete-Hastings-Massie association is similar to that in the Hastings-Crete and Crete-Butler associations, but the number of permanent wetlands is larger. Several of these, such as the Mallard Haven National Wildlife Management Area northwest of Shickley, are owned by the U.S. Fish and Wildlife Service. Dryland and irrigated crops in areas of this association provide summer food and cover for many species of wildlife, but the lack of undisturbed nesting cover limits the population of pheasant and bobwhite quail. Including alfalfa in the cropping sequence helps to provide more nesting cover. Delayed mowing of the alfalfa also is beneficial.

The Olbut-Butler association consists of openland and wetlands. The major soils have a perched water table. During wet periods, water is at or near the surface. The soils are suited to a permanent cover of grasses, and much of the association is used for pasture or range. The common woody plants are cottonwood, plum, mulberry, and chokecherry. Such wildlife species as pocket gopher, ground squirrel, badger, and skunk are common.

The elements essential for a wide variety of wildlife species are available in areas of the Muir-Hobbs-Butler association. The stream corridors and adjacent cropland provide food, cover, and water.

The Hastings-Uly-Geary and Hastings-Crete-Geary associations have similar habitat characteristics, but the latter supports more bur oak. The other common woody plants in areas of these associations are ash, elm, hackberry, honeylocust, sumac, mulberry, willow, cottonwood, redcedar, plum, chokecherry, and dogwood. White-tailed deer, bobwhite quail, pheasant, songbirds, tree squirrels, and cottontail rabbits inhabit these associations.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 11, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and grain sorghum.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, orchardgrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface

stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are big and little bluestem, goldenrod, beggarweed, western wheatgrass, and sideoats grama.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are bur oak, cottonwood, green ash, honeylocust, mulberry, dogwood, black walnut, gooseberry, and wild grape. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and cotoneaster.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are American plum, chokecherry, snowberry, and sumac.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild flax, reed canarygrass, saltgrass, cordgrass, rushes, sedges, and cattails.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include owls, hawks, songbirds, woodpeckers, squirrels, opossum, raccoon, deer, and skunks.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include white-tailed deer, pheasant, meadowlark, and prairie dog.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground

cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 12 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 13 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 13 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 60 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 13 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 13 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 14 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many

soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 14, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 15 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 19.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 16 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 15). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

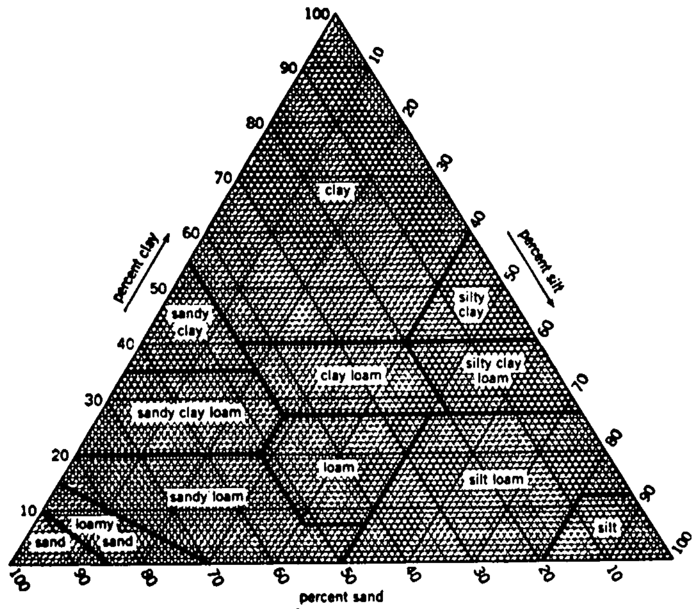


Figure 15.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in

group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 19.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 17 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume

change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 17, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 18 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 18 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 18 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 18.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Physical and Chemical Analyses of Selected Soils

Samples from soil profiles were collected for physical and chemical analyses by the Soil Survey Laboratory of the Soil Conservation Service, Lincoln, Nebraska. The samples collected were of the Butler, Crete, Fillmore, Olbut, and Scott soils in Fillmore County and the

Hastings and Massie soils in adjoining counties. The data are available at the Soil Survey Laboratory.

The information gathered from the analyses is useful to soil scientists in classifying soils and developing concepts of soil genesis. It is further helpful in estimating available water capacity, susceptibility to soil blowing, levels of fertility, tilth, and other characteristics used in planning soil management.

Engineering Index Test Data

Table 19 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are representative of the series described in the section "Soil Series and Their Morphology." The soil samples were tested by Nebraska Department of Roads.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); and Specific gravity—T 100 (AASHTO). The group index number that is part of the AASHTO classification is computed by the Nebraska modified system.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*7*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 20 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ustolls (*Ust*, meaning intermittently dry, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Argiustolls (*Argi*, meaning argillic horizon, plus *ustoll*, the suborder of the Mollisols that have an ustic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Udic* identifies the subgroup that intergrades to a udoll. An example is Udic Argiustolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed, mesic Udic Argiustolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the underlying material can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*6*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*7*). Unless otherwise stated, matrix colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Butler Series

The Butler series consists of deep, somewhat poorly drained, slowly permeable soils on uplands and stream terraces. These soils formed in loess. Slope is 0 to 1 percent.

Butler soils are commonly adjacent to Crete, Fillmore, Hastings, Muir, and Olbut soils. Crete and Hastings soils do not have an abrupt boundary between the A and B horizons and have a chroma of more than 2 in the B horizon. They are higher on the landscape than the Butler soils. Fillmore soils have an albic horizon and are in depressions. Muir soils have less clay in the control

section than the Butler soils. They are on terraces. Olbut soils are not so deep to carbonates as the Butler soils. Also, they are slightly lower on the landscape. Their content of exchangeable sodium or soluble salts is 10 to 15 percent.

Typical pedon of Butler silt loam, 0 to 1 percent slopes, 1,380 feet south and 140 feet west of the northeast corner of sec. 3, T. 7 N., R. 1 W.

Ap—0 to 7 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable; slightly acid; abrupt smooth boundary.

A—7 to 11 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly acid; clear smooth boundary.

E—11 to 13 inches; gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak medium platy structure parting to weak fine granular; slightly hard, very friable; slightly acid; abrupt smooth boundary.

Bt1—13 to 21 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; few fine faint light olive brown (2.5Y 5/4) mottles; strong fine and medium blocky structure; very hard, very firm; many shiny ped faces; neutral; gradual smooth boundary.

Bt2—21 to 29 inches; dark gray (10YR 4/1) silty clay, very dark grayish brown (10YR 3/2) moist; few fine distinct light olive brown (2.5Y 5/4) mottles; moderate medium and coarse blocky structure; very hard, very firm; common shiny ped faces; neutral; clear smooth boundary.

BC—29 to 34 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; few fine distinct dark brown (7.5YR 4/4) mottles; moderate medium and coarse subangular blocky structure; hard, firm; common soft accumulations of calcium carbonate; strong effervescence; moderately alkaline; gradual wavy boundary.

C1—34 to 44 inches; pale olive (5Y 6/3) silty clay loam, olive (5Y 4/3) moist; common fine prominent dark brown (7.5YR 4/4) mottles; massive; hard, friable; common fine accumulations of calcium carbonate; slight effervescence; moderately alkaline; gradual wavy boundary.

C2—44 to 60 inches; pale yellow (5Y 7/3) silty clay loam, olive (5Y 5/3) moist; common fine prominent dark brown (7.5YR 4/4) mottles; massive; slightly hard, very friable; slight effervescence; moderately alkaline.

The thickness of the solum ranges from 30 to 50 inches. The depth to free carbonates ranges from 24 to 38 inches. Reaction is medium acid to neutral in the A and E horizons, slightly acid to mildly alkaline in the Bt horizon, and mildly alkaline or moderately alkaline in the BC and C horizons.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is typically silt loam but in some areas is silty clay loam. The E horizon has value of 4 to 6 (3 moist) and chroma of 1. The Bt horizon has hue of 10YR or 2.5Y, value of 3 or 4 (2 or 3 moist), and chroma of 1 or 2. It is silty clay in which the clay content ranges from 45 to 55 percent. The BC horizon has hue of 10YR, 2.5Y, or 5Y, value of 5 or 6 (3 or 4 moist), and chroma of 1 or 2. It is silty clay loam or silty clay. The C horizon has hue of 10YR, 2.5Y, or 5Y, value of 5 to 7 (4 or 5 moist), and chroma of 2 or 3. It is silt loam or silty clay loam. Where calcium carbonates occur as concretions, the soil matrix is generally noncalcareous.

Crete Series

The Crete series consists of deep, moderately well drained, slowly permeable soils on uplands (fig. 16). These soils formed in loess. Slope ranges from 0 to 6 percent.

Crete soils are commonly adjacent to Butler, Fillmore, and Hastings soils. Butler soils have an abrupt boundary between the A and B horizons. They are in plane or slightly concave areas in basins. Fillmore soils have an albic horizon. They are in depressions. Hastings soils have less clay in the control section than the Crete soils and are dark to a depth of less than 20 inches. They are in positions on the landscape similar to those of the Crete soils or are in the more sloping areas.

Typical pedon of Crete silt loam, 0 to 1 percent slopes, 2,110 feet south and 100 feet west of the northeast corner of sec. 15, T. 5 N., R. 4 W.

Ap—0 to 7 inches; grayish brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; hard, very friable; few fine roots; strongly acid; abrupt smooth boundary.

A—7 to 12 inches; grayish brown (10YR 5/2) silty clay loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure parting to moderate medium granular; hard, very friable; few fine roots; common worm casts; medium acid; clear smooth boundary.

Bt1—12 to 16 inches; dark brown (10YR 4/3) silty clay, dark brown (10YR 3/3) moist; moderate coarse prismatic structure parting to strong fine and medium subangular blocky; very hard, very firm, sticky; few fine roots; slightly acid; clear smooth boundary.

Bt2—16 to 24 inches; dark brown (10YR 4/3) silty clay, dark brown (10YR 3/3) moist; moderate coarse prismatic structure parting to strong fine and medium subangular blocky; very hard, very firm, sticky; few very fine roots; many shiny ped faces; neutral; gradual smooth boundary.

Bt3—24 to 33 inches; brown (10YR 5/3) silty clay, dark brown (10YR 4/3) moist; moderate coarse prismatic

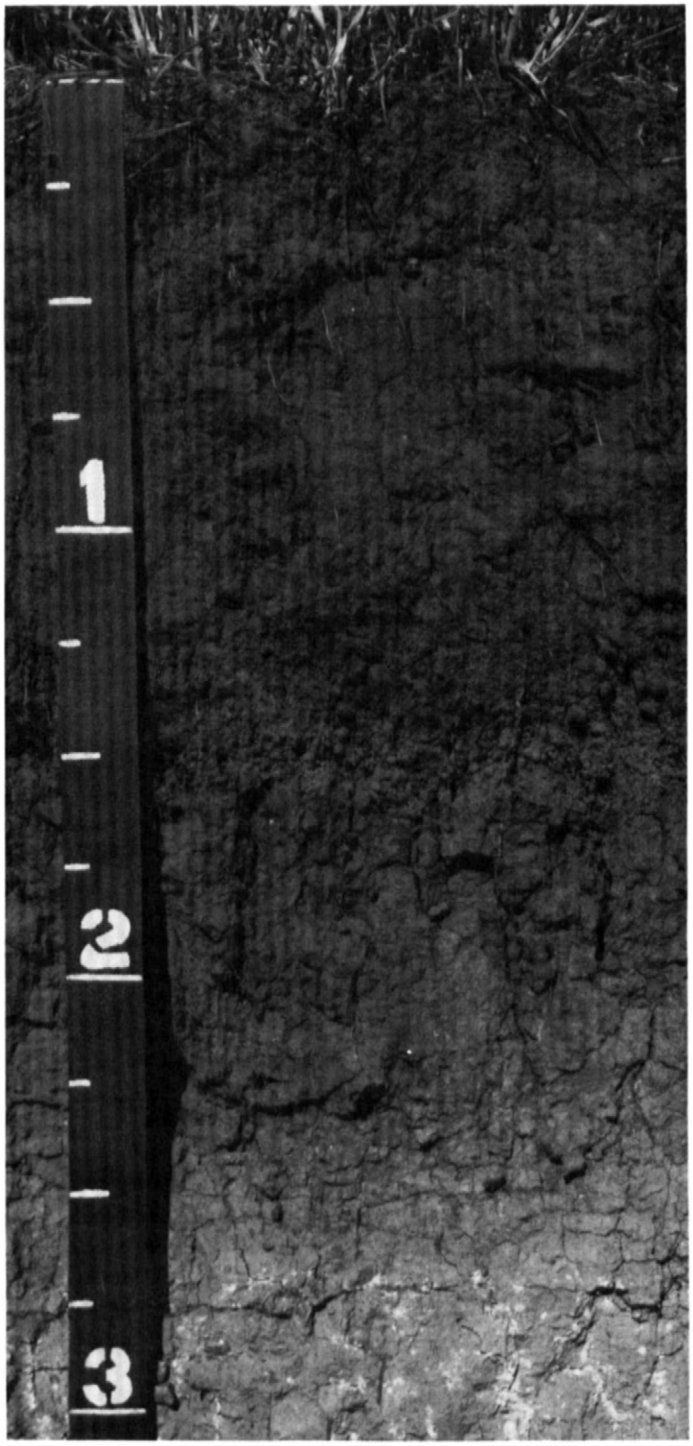


Figure 16.—Profile of Crete silt loam, 0 to 1 percent slopes. Roots cannot easily penetrate the prismatic and blocky claypan subsoil. (Scale is in feet.)

structure parting to strong medium subangular blocky; very hard, very firm, sticky; few very fine roots; many shiny ped faces; few cracks filled with darker material from the horizon above; few worm casts; mildly alkaline; gradual wavy boundary.

BC—33 to 43 inches; light yellowish brown (10YR 6/4) silty clay loam, brown (10YR 4/3) moist; few medium faint yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable; few very fine roots; few fine concretions of calcium carbonate; slight effervescence; moderately alkaline; gradual wavy boundary.

C1—43 to 48 inches; light yellowish brown (10YR 6/4) silty clay loam, yellowish brown (10YR 5/4) moist; many medium prominent reddish brown (5YR 5/4) mottles; massive; slightly hard, very friable; common fine concretions of calcium carbonate; slight effervescence; moderately alkaline; gradual wavy boundary.

C2—48 to 60 inches; light yellowish brown (10YR 6/4) silty clay loam, yellowish brown (10YR 5/4) moist; many fine and medium distinct brown (7.5YR 5/4) mottles; massive; slightly hard, very friable; common fine concretions of calcium carbonate; slight effervescence; moderately alkaline.

The thickness of the solum ranges from 30 to 50 inches. The depth to free carbonates generally ranges from 25 to 40 inches, but some pedons do not have carbonates. The thickness of the mollic epipedon ranges from 20 to 30 inches. Reaction is medium acid or strongly acid in the A horizon, strongly acid to neutral in the upper part of the Bt horizon, neutral or mildly alkaline in the lower part of the Bt horizon, and mildly alkaline or moderately alkaline in the BC and C horizons.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is silt loam or silty clay loam. The upper part of the Bt horizon has value of 4 or 5 (3 moist) and chroma of 2 or 3. The lower part has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 or 3. The Bt horizon is silty clay in which the content of clay ranges from 42 to 52 percent. The thick solum phase is at the low end of the range. The BC and C horizons have hue of 10YR, 2.5Y, or 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. The BC horizon is mottled in some pedons. The C horizon is silt loam or silty clay loam. In pedons where calcium carbonates occur as concretions, the soil mass commonly is noncalcareous.

In the Crete soils in map units Cr and CrB, the thickness of the mollic epipedon and of the solum and the depth to carbonates are slightly less than is defined as the range for the series. In the Crete soil in map unit CrC2, the surface layer is slightly lighter in color, the solum is slightly thinner, and the depth to carbonates is slightly less than is defined as the range for the series. These differences only slightly alter the usefulness or behavior of the soils.

Fillmore Series

The Fillmore series consists of deep, poorly drained, very slowly permeable soils in shallow upland depressions (fig. 17). These soils formed in loess. Slope is 0 to 1 percent.

Fillmore soils are commonly adjacent to Butler, Massie, and Scott soils. Butler soils do not have an albic horizon. They are somewhat poorly drained and are in plane or slightly concave basins above the Fillmore soils. Massie soils have a thin organic layer on the surface and typically have a solum that is thicker than that of the Fillmore soils. The surface soil in Scott soils is thinner than that in the Fillmore soils. Massie and Scott soils are more poorly drained than the Fillmore soils and have more ponded water on the surface. Also, the water stays on the surface for a longer period.

Typical pedon of Fillmore silt loam, 0 to 1 percent slopes, 325 feet north and 135 feet east of the southwest corner of sec. 19, T. 6 N., R. 4 W.

A—0 to 7 inches; grayish brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable; many fine and medium roots; strongly acid; clear wavy boundary.

E1—7 to 11 inches; gray (10YR 5/1) silt loam, dark gray (10YR 4/1) moist; common fine faint dark yellowish brown (10YR 4/4) mottles; moderate thin platy structure; soft, very friable; many fine roots; medium acid; clear wavy boundary.

E2—11 to 14 inches; light gray (10YR 6/1) silt loam, gray (10YR 5/1) moist; few fine faint yellowish brown (10YR 5/6) mottles; moderate thin platy structure; soft, very friable; common fine roots; slightly acid; abrupt wavy boundary.

Bt1—14 to 25 inches; very dark gray (10YR 3/1) silty clay, black (10YR 2/1) moist; weak coarse prismatic structure parting to strong coarse blocky; very hard, very firm, very sticky; few fine roots; common cracks; few shiny ped faces; few fine dark brown round masses of iron and manganese; slightly acid; gradual smooth boundary.

Bt2—25 to 36 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; moderate very coarse prismatic structure parting to strong coarse blocky; very hard, very firm, very sticky; few fine roots; few fine dark brown round masses of iron and manganese; few shiny ped faces; neutral; gradual smooth boundary.

Bt3—36 to 55 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to strong coarse blocky; very hard, very firm, sticky; few fine roots; common shiny ped faces; few fine dark brown round masses of iron and manganese; mildly alkaline; gradual wavy boundary.

BC—55 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (10YR 4/2) moist; few fine distinct dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; very hard, firm, slightly sticky; few fine roots; few fine dark brown round masses of iron and

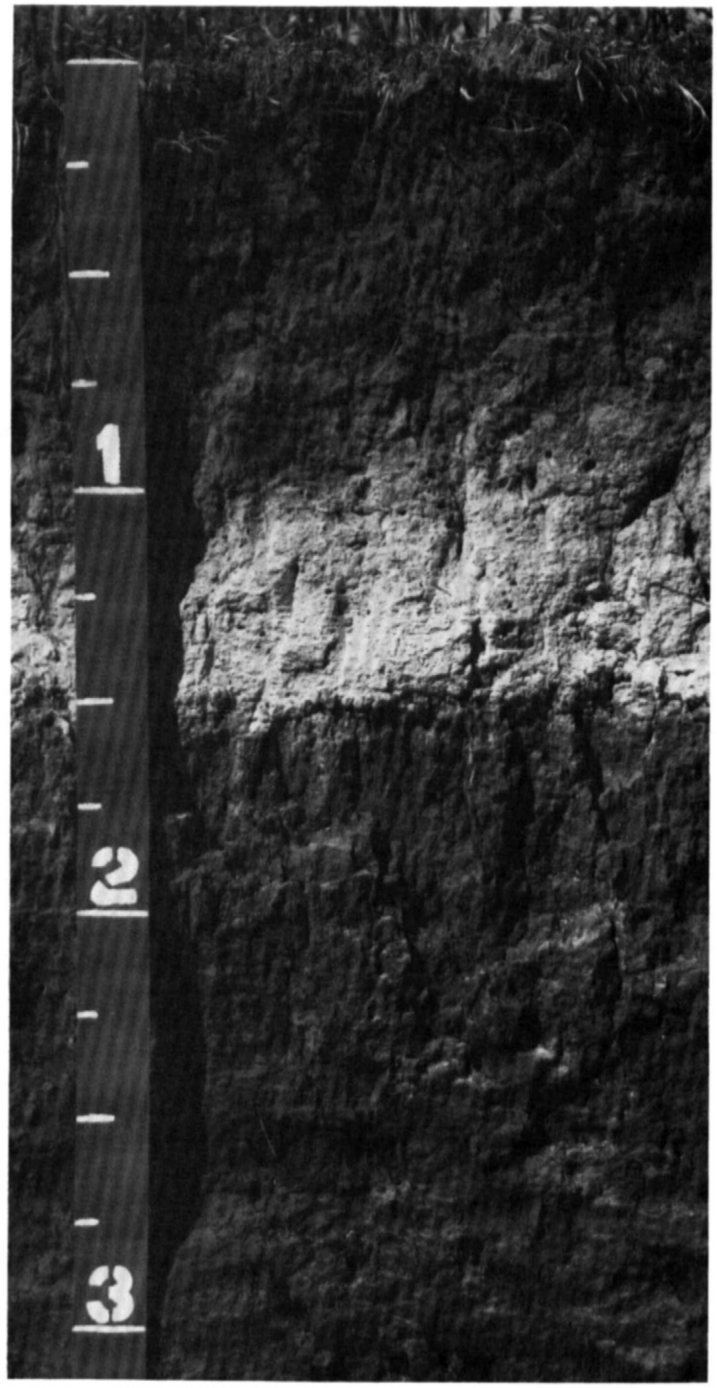


Figure 17.—Profile of Fillmore silt loam, 0 to 1 percent slopes. Clay has been leached from the light colored E horizon. (Scale is in feet.)

manganese; few dark streaks in cracks; few fine concretions of calcium carbonate; neutral.

The thickness of the solum and the depth to free carbonates range from 30 to more than 60 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It typically is silt loam, but the range includes silty clay loam. The E horizon has value of 5 to 7 (4 or 5 moist) and chroma of 1. It has platy or granular structure. The A and E horizons are slightly acid to strongly acid. The Bt horizon has hue of 10YR or 2.5Y, value of 3 to 5 (2 to 4 moist), and chroma of 1 or 2. It is silty clay loam or silty clay. The clay content in this horizon is 38 to 50 percent.

Some pedons have a C horizon. This horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is silt loam or silty clay loam. It has soft accumulations or concretions of carbonate and is mottled in some pedons. It is mildly alkaline or moderately alkaline. Concretions of iron and manganese oxides are in the upper part of the C horizon in some pedons.

Geary Series

The Geary series consists of deep, well drained and somewhat excessively drained, moderately slowly permeable soils on uplands. These soils formed in reddish brown material that is presumed to be loess. Slope ranges from 3 to 30 percent.

Geary soils are similar to Holder soils and are commonly adjacent to Hastings, Holder, and Uly soils. The adjacent soils do not have a reddish hue in the B horizon. They are higher on the landscape than the Geary soils. Also, Hastings soils have more clay and Uly soils less clay in the control section. Holder soils have hue of 10YR in the B horizon.

Typical pedon of Geary silt loam, in an area of Geary-Hobbs silt loams, 0 to 30 percent slopes, 1,580 feet east and 225 feet north of the southwest corner of sec. 1, T. 8 N., R. 4 W.

A—0 to 6 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; soft, very friable; slightly acid; clear wavy boundary.

BA—6 to 10 inches; brown (7.5YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate very fine subangular blocky structure; hard, friable; slightly acid; clear wavy boundary.

Bt1—10 to 20 inches; brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/4) moist; few organic coatings on faces of peds; moderate medium and fine blocky structure; hard, firm; slightly acid; gradual wavy boundary.

Bt2—20 to 30 inches; light brown (7.5YR 6/4) silty clay loam, brown (7.5YR 5/4) moist; moderate medium blocky structure; hard, firm; slightly acid; clear smooth boundary.

BC—30 to 36 inches; light brown (7.5YR 6/4) silty clay loam, strong brown (7.5YR 5/6) moist; weak coarse subangular blocky structure; hard, friable; mildly alkaline; gradual wavy boundary.

C—36 to 60 inches; pink (7.5YR 7/4) silty clay loam, brown (7.5YR 5/4) moist; massive; slightly hard, friable; few concretions and soft accumulations of calcium carbonate; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 30 to 45 inches. The depth to free carbonates ranges from 36 to more than 60 inches. The thickness of the mollic epipedon ranges from 10 to 20 inches.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 (3 moist), and chroma of 2 or 3. It is silt loam or silty clay loam. It is medium acid or slightly acid. The Bt horizon has chroma of 3 to 6. It is silty clay loam or clay loam in which the clay content is 27 to 35 percent. This horizon commonly has organic coatings on the faces of peds. It is medium acid to mildly alkaline. The BC and C horizons are silty clay loam or clay loam. The C horizon has hue of 10YR or 7.5YR, value of 6 or 7 (5 moist), and chroma of 4 to 6. It is neutral to moderately alkaline. Scattered sand grains are throughout most pedons.

In the Geary soils in map units GeC2, GeD2, and GeE2, the surface layer is slightly lighter in color than is defined as the range for the series. Also, the Geary soils in map units GeD2 and GeE2 are shallower to carbonates. These differences only slightly alter the usefulness or behavior of the soils.

Hastings Series

The Hastings series consists of deep, well drained, moderately slowly permeable soils on uplands (fig. 18). These soils formed in silty loess. Slope ranges from 0 to 11 percent.

Hastings soils are commonly adjacent to Crete, Geary, and Uly soils. Crete soils are dark to a depth of 20 inches or more and have more clay in the control section than the Hastings soils. They are in positions on the landscape similar to those of the Hastings soils but are moderately well drained. Geary and Uly soils contain less clay in the control section than the Hastings soils and are lower on the landscape. Also, Geary soils have redder hue in the B horizon.

Typical pedon of Hastings silt loam, 1 to 3 percent slopes, 2,320 feet west and 126 feet north of the southeast corner of sec. 11, T. 8 N., R. 4 W.

Ap—0 to 7 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak thick platy structure parting to weak fine granular;

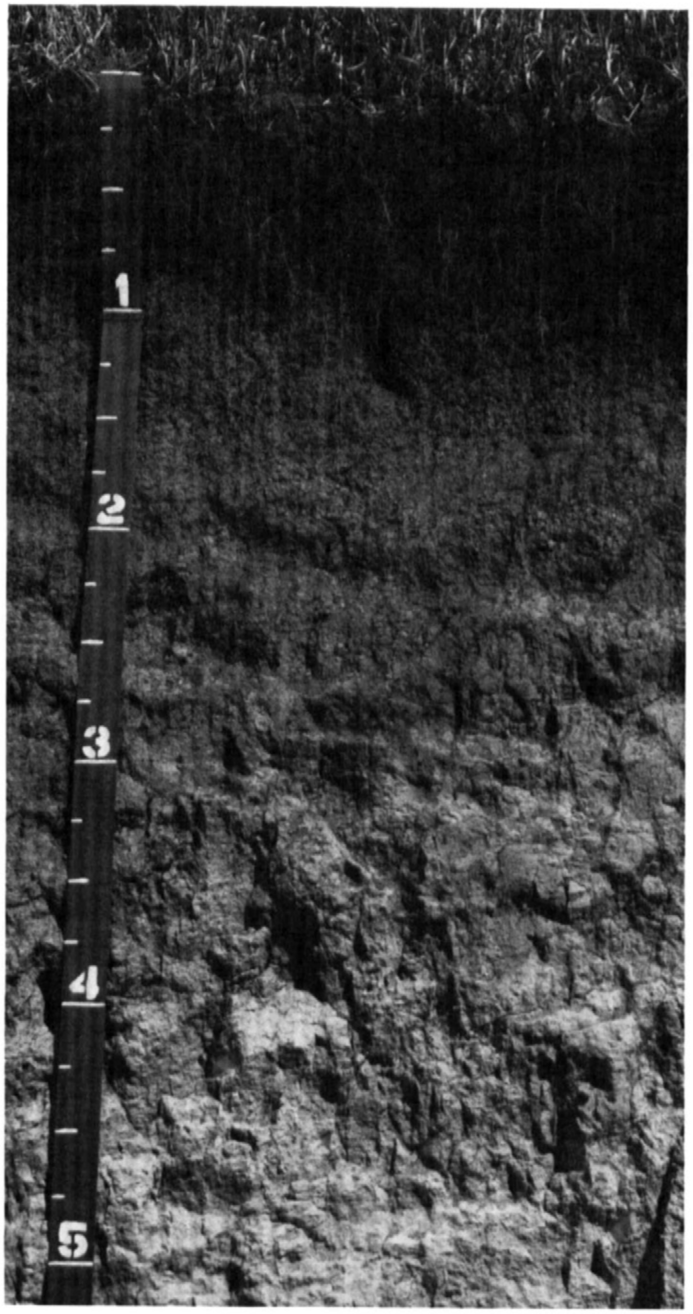


Figure 18.—Profile of Hastings silt loam, 1 to 3 percent slopes. Roots can readily penetrate the prismatic and blocky subsoil. (Scale is in feet.)

soft, very friable; medium acid; abrupt smooth boundary.

BA—7 to 12 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate very fine subangular blocky structure; slightly hard, friable; neutral; clear smooth boundary.

Bt1—12 to 20 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate fine and very fine blocky; hard, firm; organic coatings on faces of peds; neutral; gradual smooth boundary.

Bt2—20 to 28 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate medium blocky; hard, firm; organic coatings on faces of peds; neutral; gradual smooth boundary.

BC—28 to 35 inches; pale brown (10YR 6/3) silty clay loam, light olive brown (2.5Y 5/4) moist; few fine faint yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure parting to weak coarse subangular blocky; hard, friable; neutral; gradual smooth boundary.

C1—35 to 45 inches; pale brown (10YR 6/3) silt loam, light olive brown (2.5Y 5/4) moist; common fine faint yellowish brown (10YR 5/6) mottles; moderate coarse prismatic structure parting to weak coarse subangular blocky; soft, very friable; neutral; clear smooth boundary.

C2—45 to 60 inches; pale brown (10YR 6/3) silt loam, light olive brown (2.5Y 5/4) moist; common fine faint yellowish brown (10YR 5/6) mottles; massive; soft, very friable; many fine and medium concretions and soft accumulations of calcium carbonate; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 24 to 45 inches. The depth to free carbonates ranges from 40 to more than 60 inches. The thickness of the mollic epipedon ranges from 8 to 20 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is medium acid or slightly acid. It is silt loam or silty clay loam. The Bt horizon has hue of 10YR or 2.5Y and chroma of 2 or 3. It is slightly acid or neutral. It is silty clay loam or silty clay in which the clay content is 35 to 42 percent. This horizon has organic coatings on the faces of most peds. The BC and C horizons have hue of 10YR or 2.5Y, value of 5 to 7 (5 or 6 moist), and chroma of 2 to 4. They are neutral to moderately alkaline.

In the Hastings soil in map unit HdC3, the surface layer is lighter in color, the solum is thinner, and the depth to carbonates is less than is defined as the range for the series. These differences only slightly alter the usefulness or behavior of the soils.

Hobbs Series

The Hobbs series consists of deep, well drained, moderately permeable soils on bottom lands along intermittent and perennial streams. These soils formed in

stratified, silty alluvium. Slope ranges from 0 to 2 percent.

Hobbs soils are commonly adjacent to Muir and Kezan soils. Muir soils are dark to a depth of 20 inches or more, have a B horizon, and are on stream terraces. Kezan soils are mottled in the control section and are poorly drained.

Typical pedon of Hobbs silt loam, 0 to 2 percent slopes, 2,590 feet east and 345 feet south of the northwest corner of sec. 24, T. 7 N., R. 4 W.

Ap—0 to 9 inches; dark gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) moist; moderate medium granular structure; hard, friable; neutral; abrupt smooth boundary.

C1—9 to 32 inches; stratified dark grayish brown (2.5Y 4/2) and grayish brown (2.5Y 5/2) silt loam, very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) moist; moderate medium granular structure; hard, very friable; slightly acid; clear smooth boundary.

C2—32 to 45 inches; dark gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) moist; moderate fine and medium granular structure; slightly hard, very friable; slightly acid; clear smooth boundary.

C3—45 to 56 inches; grayish brown (2.5Y 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium granular structure; hard, very friable; slightly acid; gradual smooth boundary.

C4—56 to 60 inches; stratified grayish brown (10YR 5/2) and light gray (10YR 7/2) silt loam, dark grayish brown (10YR 4/2) and light brownish gray (10YR 6/2) moist; few fine sand lenses; massive; slightly hard, very friable; slightly acid.

The depth to free carbonates is mainly 40 inches or more. In some pedons, however, a layer that contains free carbonates is within a depth of 40 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. Typically, it is silt loam or silty clay loam but in some areas is fine sandy loam. It is stratified in undisturbed areas. It is slightly acid or neutral. The C horizon mainly is silt loam or silty clay loam, but in some pedons it has thin strata of slightly coarser or finer textured material. It is slightly acid to mildly alkaline. A buried soil is common.

Holder Series

The Holder series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in loess. Slope ranges from 6 to 11 percent.

Holder soils are similar to Geary soils and are commonly adjacent to Hastings, Geary, and Uly soils. Hastings soils have more clay in the control section than the Holder soils. They are in positions on the landscape similar to those of the Holder soils. Geary and Uly soils are lower on the landscape than the Holder soils. Also, Geary soils have a redder hue in the B horizon, and Uly soils have less clay in the control section.

Typical pedon of Holder silty clay loam, 6 to 11 percent slopes, eroded, 200 feet west and 100 feet north of the southeast corner of sec. 29, T. 8 N., R. 4 W.

Ap—0 to 5 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to weak medium granular; hard, firm; slightly acid; abrupt smooth boundary.

Bt—5 to 10 inches; brown (10YR 5/3) silty clay loam, brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate medium blocky; hard, firm; organic coatings on faces of peds; neutral; clear smooth boundary.

BC—10 to 18 inches; light olive brown (2.5Y 5/4) silty clay loam, olive brown (2.5Y 4/4) moist; common fine distinct strong brown (7.5YR 5/6) and dark brown (7.5YR 4/4) mottles; weak coarse prismatic structure parting to weak medium subangular blocky; hard, friable; neutral; gradual smooth boundary.

C1—18 to 53 inches; light yellowish brown (2.5Y 6/4) silt loam, light olive brown (2.5Y 5/4) moist; common fine distinct strong brown (7.5YR 5/6) and dark brown (7.5YR 4/4) mottles; massive; slightly hard, very friable; neutral; clear smooth boundary.

C2—53 to 60 inches; pale brown (10YR 6/3) silt loam, light olive brown (2.5Y 5/4) moist; common fine distinct strong brown (7.5YR 5/6) and dark brown (7.5YR 4/4) mottles; massive; soft, very friable; common fine concretions and soft masses of calcium carbonate; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 18 to 30 inches. The depth to free carbonates ranges from 36 to 60 inches. After mixing, the mollic epipedon is 7 to 10 inches thick.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is slightly acid or neutral. The Bt horizon also is slightly acid or neutral. It has value of 5 or 6. The clay content in this horizon is 30 to 35 percent. The BC and C horizons have hue of 10YR or 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 3 or 4. They are neutral to moderately alkaline. They are mottled in some pedons.

Kezan Series

The Kezan series consists of deep, poorly drained, moderately permeable soils on bottom lands along narrow upland drainageways. These soils formed in alluvial material. Slope ranges from 0 to 2 percent.

Kezan soils are commonly adjacent to Geary, Hobbs, and Olbut soils. Geary soils have a B horizon and are on upland slopes. Hobbs soils do not have mottles in the

control section and are well drained. Olbut soils have a B horizon, are somewhat poorly drained, and are on uplands. Their content of exchangeable sodium is 10 to 15 percent.

Typical pedon of Kezan silt loam, channeled, 1,580 feet north and 250 feet west of the southeast corner of sec. 8, T. 7 N., R. 1 W.

A—0 to 5 inches; stratified grayish brown (10YR 5/2) and gray (10YR 5/1) silt loam, very dark grayish brown (10YR 3/2) and very dark gray (10YR 3/1) moist; moderate medium granular structure; hard, friable; slightly acid; clear smooth boundary.

C1—5 to 19 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; massive; hard, friable; slightly acid; gradual smooth boundary.

C2—19 to 30 inches; gray (10YR 5/1) silty clay loam, very dark gray (10YR 3/1) moist; massive; hard, very friable; slightly acid; clear smooth boundary.

C3—30 to 38 inches; stratified grayish brown (10YR 5/2) and dark grayish brown (10YR 4/2) silty clay loam, dark grayish brown (10YR 4/2) and very dark grayish brown (10YR 3/2) moist; few fine distinct dark brown (7.5YR 4/4) mottles; massive; hard, very friable; slightly acid; gradual smooth boundary.

C4—38 to 60 inches; stratified light brownish gray (2.5Y 6/2) and dark grayish brown (2.5Y 4/2) silty clay loam, dark grayish brown (2.5Y 4/2) and very dark grayish brown (2.5Y 3/2) moist; few fine distinct dark brown (7.5YR 4/4) mottles; massive; hard, very friable; slightly acid.

Reaction is slightly acid to moderately alkaline throughout the profile. In some pedons the soils are calcareous below a depth of 12 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is silt loam or silty clay loam. A buried soil is below a depth of 20 inches in some pedons. The C horizon has hue of 10YR or 2.5Y. It is silt loam or silty clay loam.

Massie Series

The Massie series consists of deep, very poorly drained, very slowly permeable soils in the lowest, wettest parts of upland depressions. These soils formed in loess. Slope is 0 to 1 percent.

Massie soils are commonly adjacent to Fillmore and Scott soils. The adjacent soils do not have a thin organic layer on the surface and typically have a solum that is thicker than that of the Massie soils. Also, they are less poorly drained. The ponded water on the surface of the Fillmore and Scott soils is shallower than that on the Massie soils, and it stays on the surface for a shorter period.

Typical pedon of Massie silty clay loam, 0 to 1 percent slopes, 2,220 feet north and 100 feet west of the southeast corner of sec. 26, T. 6 N., R. 4 W.

A—0 to 6 inches; dark gray (10YR 4/1) silty clay loam, black (10YR 2/1) moist; common fine distinct strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure parting to moderate medium granular; hard, friable; layer of partially decayed leaves and stems on the surface; slightly acid; abrupt wavy boundary.

E—6 to 8 inches; light gray (10YR 6/1) silt loam, dark gray (10YR 4/1) moist; common fine distinct strong brown (7.5YR 5/6) mottles; strong thin platy structure parting to weak fine granular; soft, very friable; slightly acid; abrupt wavy boundary.

Bt1—8 to 20 inches; gray (10YR 5/1) silty clay loam, black (10YR 2/1) moist; many fine and medium distinct strong brown (7.5YR 5/6) mottles; strong medium and fine blocky structure; very hard, very firm; shiny ped faces; few fine dark concretions (iron and manganese oxides); medium acid; clear wavy boundary.

Bt2—20 to 37 inches; gray (10YR 5/1) silty clay, black (10YR 2/1) moist; moderate medium subangular blocky structure; very hard, very firm; shiny ped faces; few fine dark concretions (iron and manganese oxides); medium acid; gradual wavy boundary.

Bt3—37 to 44 inches; gray (10YR 5/1) silty clay, very dark gray (10YR 3/1) moist; moderate coarse subangular blocky structure; very hard, very firm; shiny ped faces; few fine dark concretions (iron and manganese oxides); neutral; gradual wavy boundary.

BC1—44 to 52 inches; light brownish gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) moist; common fine and medium distinct brownish yellow (10YR 6/6) and strong brown (7.5YR 5/6) mottles; moderate coarse subangular blocky structure; very hard, very firm; neutral; gradual wavy boundary.

BC2—52 to 60 inches; pale olive (5Y 6/3) silty clay loam, olive (5Y 5/3) moist; many fine and medium prominent brownish yellow (10YR 6/6) and strong brown (7.5YR 5/6) mottles; weak coarse subangular blocky structure; hard, firm; neutral.

The thickness of the solum and the depth to free carbonates range from 51 to more than 60 inches. Reaction is slightly acid or medium acid in the A and E horizons, medium acid to neutral in the Bt horizon, slightly acid or neutral in the BC horizon, and neutral or mildly alkaline in the C horizon.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It typically is silty clay loam but in some pedons is silt loam, silty clay, or clay. The E horizon has value of 5 or 6 (4 or 5 moist) and chroma of 1. In some pedons it has iron-manganese concretions in the lower part. The Bt horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It is silty clay loam or silty clay in which the clay content is 36 to 50 percent. The BC horizon has hue of 10YR,

2.5Y or 5Y, value of 4 to 6 (3 to 5 moist), and chroma of 1 to 3. In some pedons it has iron-manganese concretions in the lower part.

Some pedons have a C horizon. This horizon has hue of 10YR, 2.5Y or 5Y, value of 4 to 7 (4 to 6 moist), and chroma of 1 to 3. It is silt loam, silty clay loam, or silty clay.

Muir Series

The Muir series consists of deep, well drained, moderately permeable soils on stream terraces and colluvial foot slopes. These soils formed in silty alluvium (fig. 19). Slope ranges from 0 to 6 percent.

Muir soils are commonly adjacent to Butler and Hobbs soils. Butler soils have more clay in the control section than the Muir soils and have a thin E horizon. Hobbs soils are stratified within a depth of 10 inches and are on bottom lands.

Typical pedon of Muir silt loam, 0 to 1 percent slopes, 2,220 feet west and 90 feet south of the northeast corner of sec. 5, T. 6 N., R. 1 W.

Ap—0 to 7 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; slightly acid; abrupt smooth boundary.

A—7 to 15 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak medium granular structure; slightly hard, very friable; neutral; clear smooth boundary.

Bw1—15 to 24 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak fine subangular blocky; hard, friable; neutral; gradual smooth boundary.

Bw2—24 to 36 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; hard, friable; neutral; gradual smooth boundary.

C—36 to 48 inches; stratified grayish brown (10YR 5/2) and light gray (10YR 7/2) silt loam, dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) moist; massive; slightly hard, very friable; neutral; abrupt smooth boundary.

Ab—48 to 60 inches; stratified dark grayish brown (10YR 4/2) and gray (10YR 6/1) silt loam, very dark grayish brown (10YR 3/2) and dark gray (10YR 4/1) moist; weak medium granular structure; slightly hard, very friable; neutral.

The thickness of the solum ranges from 30 to 55 inches. The thickness of the mollic epipedon ranges from 20 to 40 inches. In most pedons the depth to free carbonates is more than 60 inches. In some pedons, however, it is 48 to 60 inches.

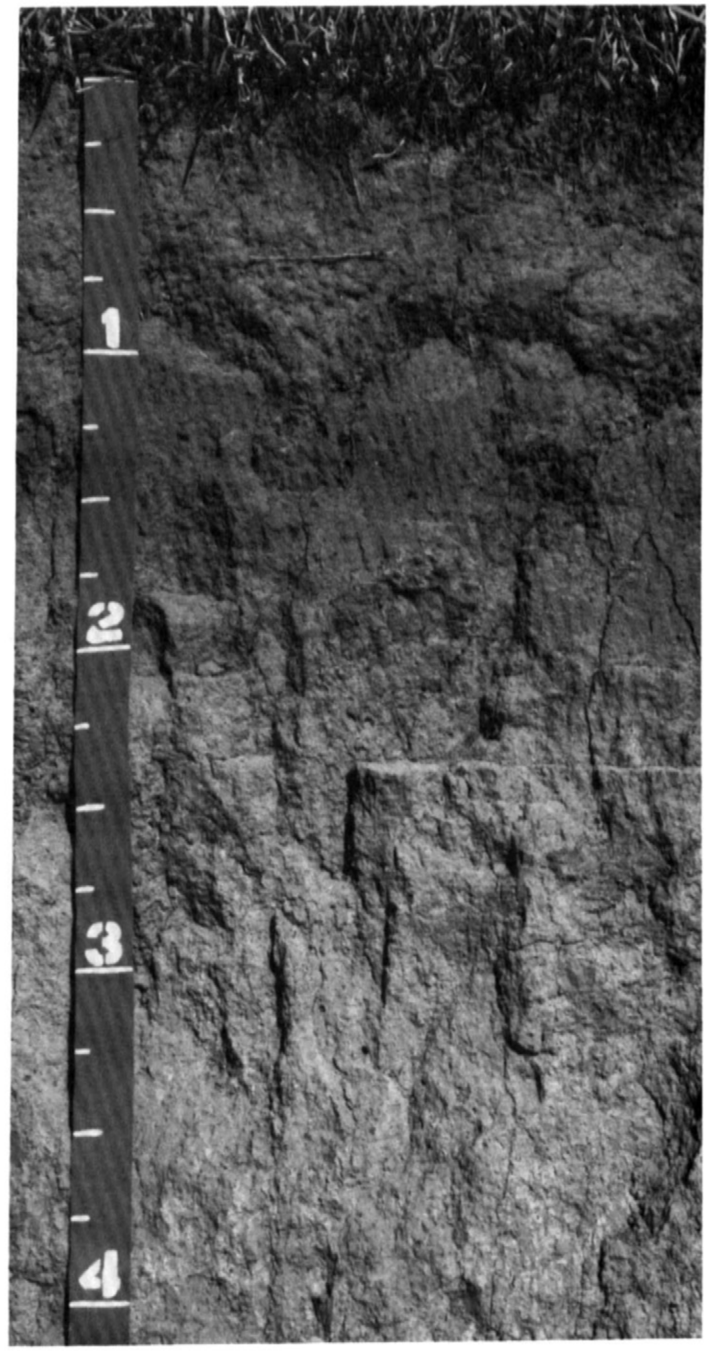


Figure 19.—Profile of Muir silt loam, 0 to 1 percent slopes. The texture is silt loam throughout the profile. (Scale is in feet.)

The A horizon has chroma of 1 or 2. It is dominantly silt loam, but in some areas it is silty clay loam. It is medium acid to neutral. The Bw horizon has value of 4 to 6 (3 to 5 moist) and chroma of 2 or 3. It is silty clay loam or silt loam. It is slightly acid or neutral. Some

pedons do not have an Ab horizon. The C horizon is silt loam, loam, or silty clay loam and commonly is stratified. It is neutral or mildly alkaline.

Olbut Series

The Olbut series consists of deep, somewhat poorly drained, slowly permeable, saline soils on uplands. These soils formed in loess. Slope is 0 to 1 percent.

Olbut soils are commonly adjacent to Butler, Crete, and Fillmore soils, which do not have soluble salts or exchangeable sodium and which are deeper to carbonates than the Olbut soils. Butler soils and the moderately well drained Crete soils are higher on the landscape than the Olbut soils. Fillmore soils are in depressions.

Typical pedon of Olbut silt loam, in an area of Olbut-Butler silt loams, 0 to 1 percent slopes, 2,530 feet south and 620 feet east of northwest corner of sec. 26, T. 8 N., R. 2 W.

Ap—0 to 7 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; light gray (10YR 7/2) lenses of coarse silt or very fine sand, grayish brown (10YR 5/2) moist; weak very thick platy and weak very fine granular structure; hard, very friable; slightly acid; abrupt smooth boundary.

Bt—7 to 11 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; gray coatings on faces of peds; strong fine and very fine blocky structure; very hard, very firm; mildly alkaline; abrupt smooth boundary.

Btz1—11 to 19 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; few fine faint olive brown (2.5Y 4/4) mottles; moderate medium and fine blocky structure; very hard, very firm; many fine salt clusters; violent effervescence; mildly alkaline; gradual wavy boundary.

Btz2—19 to 32 inches; gray (10YR 5/1) silty clay, dark gray (10YR 4/1) moist; few fine faint olive brown (2.5Y 4/4) mottles; moderate coarse subangular blocky structure; very hard, very firm; many fine and medium salt clusters; violent effervescence; moderately alkaline; gradual wavy boundary.

BCz—32 to 40 inches; olive gray (5Y 5/2) silty clay loam, olive gray (5Y 4/2) moist; few fine distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; very hard, firm; many fine and medium salt clusters; violent effervescence; moderately alkaline; gradual wavy boundary.

Cz—40 to 60 inches; pale yellow (5Y 7/3) silty clay loam, olive (5Y 5/3) moist; many fine distinct yellowish brown (10YR 5/6 and 5/8) mottles; massive; hard, very friable; common fine salt clusters; mildly alkaline; strong effervescence.

The thickness of the solum ranges from 22 to 40 inches. The mollic epipedon extends into the Bt horizon. The depth to carbonates ranges from 10 to 24 inches. The content of exchangeable sodium in the B horizon is 10 to 15 percent. Reaction is slightly acid to mildly alkaline in the Ap horizon and in the upper part of the Bt horizon and is mildly alkaline or moderately alkaline in the lower part of the Bt horizon and in the BC and C horizons.

The Ap horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It has lenses of light gray or gray coarse silt or very fine sand in most pedons. Some pedons have a thin, indistinct E horizon. The upper part of the Bt horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. In some pedons it has gray coatings on the faces of peds. It has salt clusters in some pedons. The lower part of the Bt horizon has hue of 10YR or 2.5Y, value of 4 or 5 (3 or 4 moist), and chroma of 1 or 2. The Bt horizon has few fine dark concretions (iron and manganese oxides) in some pedons. It is silty clay in which the clay content is 40 to 55 percent. The BC horizon has hue of 2.5Y or 5Y, value of 4 to 6 (3 to 5 moist), and chroma of 2 or 3. It is silty clay loam or silty clay. The C horizon has hue of 2.5Y or 5Y, value of 6 or 7 (3 to 5 moist), and chroma of 2 or 3. It is silt loam or silty clay loam.

Scott Series

The Scott series consists of deep, poorly drained and very poorly drained, very slowly permeable soils in the lower parts of upland depressions. These soils formed in loess. Slope is 0 to 1 percent.

Scott soils are commonly adjacent to Butler, Fillmore, and Massie soils. Butler soils do not have an albic horizon. They are in basins above the Scott soils. Fillmore soils are poorly drained. Their surface soil is thicker than that of the Scott soils. Massie soils have a thin organic layer on the surface and typically have a solum that is thicker than that of the Scott soils. Also, ponded water is deeper on the Massie soils and is on the surface for a longer period.

Typical pedon of Scott silt loam, 0 to 1 percent slopes, 2,433 feet east and 252 feet south of the northwest corner of sec. 21, T. 5 N., R. 4 W.

A—0 to 3 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable; strongly acid; many fine roots; clear smooth boundary.

E—3 to 5 inches; light gray (10YR 6/1) silt loam, dark gray (10YR 4/1) moist; weak thin platy structure; soft, very friable; many fine roots; medium acid; abrupt wavy boundary.

Bt1—5 to 11 inches; dark gray (10YR 4/1) silty clay, black (10YR 2/1) moist; many fine distinct strong brown (7.5YR 5/6) mottles; strong medium blocky structure; very hard, very firm, very sticky; many fine roots; common shiny ped faces; few fine dark brown

round masses of iron and manganese; slightly acid; clear smooth boundary.

Bt2—11 to 25 inches; gray (10YR 5/1) silty clay, black (10YR 2/1) moist; strong fine and medium blocky structure; very hard, very firm, very sticky; common fine roots; few shiny ped faces; common fine dark brown round masses of iron and manganese; neutral; clear smooth boundary.

Bt3—25 to 32 inches; gray (10YR 5/1) silty clay, very dark gray (10YR 3/1) moist; moderate coarse blocky structure; very hard, very firm, very sticky; few fine roots; few shiny ped faces; common fine dark brown round masses of iron and manganese; neutral; clear smooth boundary.

Bt4—32 to 40 inches; grayish brown (10YR 5/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate medium blocky structure; very hard, very firm, very sticky; few fine roots between cracks; few shiny ped faces; neutral; clear wavy boundary.

BC1—40 to 47 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure; hard, firm, sticky; few fine dark brown round masses of iron and manganese; neutral; gradual wavy boundary.

BC2—47 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; common medium distinct yellowish brown (10YR 5/6 and 5/8) mottles; moderate medium subangular blocky structure; hard, firm, slightly sticky; few fine dark brown round masses of iron and manganese; neutral.

The thickness of the solum and the depth to free carbonates range from 40 to more than 60 inches. Reaction is neutral to strongly acid in the A and E horizons, neutral to medium acid in the Bt horizon, and neutral or mildly alkaline in the BC and C horizons.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is silt loam or silty clay loam. The E horizon has value 5 to 7 (4 or 5 moist) and chroma of 1. The Bt horizon has hue of 10YR or 2.5Y, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. It is silty clay loam or silty clay in which the clay content is 36 to 50 percent. Some pedons have a C horizon. This horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is silt loam or silty clay loam. In some pedons it has soft accumulations or concretions of carbonate. In some pedons mottles are in the lower part of the BC horizon and in the C horizon.

Figure 20.—Profile of Uly silt loam. Accumulations of carbonate are at a depth of about 20 inches. (Scale is in feet.)

Uly Series

The Uly series consists of deep, somewhat excessively drained, moderately permeable soils on uplands (fig. 20). These soils formed in loess. Slope ranges from 11 to 30 percent.

These soils receive more precipitation than is definitive for the Uly series. Also, the Uly soil in map unit UyE2 lacks a mollic epipedon, which is definitive for the series. These differences do not alter the usefulness or behavior of the soils.

Uly soils are commonly adjacent to Geary and Hastings soils. The adjacent soils have more clay in the control section than the Uly soils. Also, Geary soils have a redder hue in the B horizon. They are gently sloping to

steep and are on the lower parts of the landscape. Hastings soils are on the less sloping, higher parts of the landscape.

Typical pedon of Uly silt loam, in an area of Uly-Hobbs silt loams, 0 to 30 percent slopes, 850 feet north and 198 feet west of the southeast corner of sec. 16, T. 8 N., R. 4 W.

A—0 to 6 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to weak medium granular; hard, very friable; neutral; gradual wavy boundary.

BA—6 to 9 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to weak very fine subangular blocky; slightly hard, friable; neutral; gradual wavy boundary.

Bw—9 to 15 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 4/3) moist; weak coarse subangular blocky structure parting to weak medium subangular blocky; hard, friable; neutral; gradual wavy boundary.

BC—15 to 20 inches; very pale brown (10YR 7/3) silt loam, light olive brown (2.5Y 5/3) moist; few fine faint yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure parting to weak coarse subangular blocky; slightly hard, friable; mildly alkaline; gradual wavy boundary.

C—20 to 60 inches; pale yellow (2.5Y 7/4) silt loam, light olive brown (2.5Y 5/4) moist; massive; soft, very friable; few soft accumulations of carbonate in pockets and along seams; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 12 to 25 inches. The depth to free carbonates is typically 8 to 25 inches but is more than 25 inches in some pedons. The thickness of the mollic epipedon ranges from 8 to 15 inches.

The A horizon has hue of 10YR or 2.5Y, value of 4 or 5 (2 or 3 moist), and chroma of 2. It is slightly acid to mildly alkaline. The B horizon has value of 4 to 7 (3 to 5 moist) and chroma of 2 or 3. It is slightly acid to moderately alkaline. The content of clay in this horizon ranges from 18 to 30 percent. The C horizon has hue of 10YR, 7.5YR, or 2.5Y, value of 6 or 7 (5 or 6 moist), and chroma of 3 or 4. It is mildly alkaline or moderately alkaline.

Formation of the Soils

This section describes how the major factors of soil formation have affected the formation of the soils in Fillmore County.

Soil forms through processes acting on deposited or accumulated geologic material. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief, or lay of the land, and (5) the length of time that the forces of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly plants, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material affects the kind of soil profile that forms and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil. Usually, a long time is needed for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four.

Climate

Climate has a direct and indirect influence on the formation of soils. The direct effect is through the weathering and reworking of soil material by rainfall, temperature, and wind. The indirect effect is through the amount and kind of plant and animal life that the climate sustains.

As precipitation falls on the surface, some water moves through the soil, carrying nutrients, clay, and organic matter from the surface layer to the subsoil or underlying layers. Leaching normally is limited to the upper 3 or 4 feet in the loess of Fillmore County. The depth to calcium carbonates and the amount of clay in the subsoil have been modified by water movement in the loess. In the claypan soils in depressions in the county, leaching and clay accumulation in the subsoil are in the advanced stages. Water that flows through drainageways removes, mixes, and redeposits unconsolidated material of all kinds. The alluvial soils in this county are examples of soils formed in water-deposited sediments.

Alternate periods of freezing and thawing speed the mechanical weathering of parent material. Frost penetrates to a depth of 2 to 4 feet if the amount of moisture is sufficient. Chemical weathering is aided by summer heat and humidity.

Wind transfers soil material from one place to another. The extensive deposits of Peorian Loess in this county are examples of material that is deposited by wind. Crete, Hastings, and Uly are examples of soils formed in wind-deposited material.

Plants provide the primary source of the organic matter in a soil. Micro-organisms and animals that live in the soil help to decay dead plants. Burrowing animals and earthworms help to mix the soil.

The climate of Fillmore County is characterized by seasonal extremes. The temperatures commonly drop below 0 degrees F in winter and climb above 100 degrees in summer. Winter is moderately long and cold and is characterized by a moderate amount of snowfall. Spring is cool and is marked by an increase in precipitation. Summer is warm. Many thundershowers occur in the early part of summer, but droughts are not uncommon in the late part. Fall is moderately long and mild and has occasional periods of rain. The climate is fairly uniform throughout the county, and differences among the soils cannot be attributed to the climate.

Parent Material

Parent material is the disintegrated and weathered rock in which a soil forms. It affects the chemical and mineralogical composition of the soil. The soils in Fillmore County formed in two main kinds of parent material—loess and alluvium.

Peorian Loess, which is wind deposited, is the most extensive type of parent material in the county. It is grayish brown, brown, and yellowish brown silt loam. It averages about 20 feet thick, but the thickness ranges from less than 1 foot to 30 feet. Crete, Hastings, Holder, and Uly soils formed in Peorian Loess. They are on uplands. Butler, Fillmore, Olbut, Scott, and Massie soils formed in Peorian Loess modified by water. They are in slightly concave areas, basins, and depressions, all of which are on uplands.

Alluvium is the second most extensive type of parent material. It consists of mostly clay and silt and some sand and gravel washed from uplands and deposited on flood plains and stream terraces. This material is mixed in different proportions and commonly is deposited in layers. Its thickness is generally about 5 feet. Hobbs, Muir, and Kezan soils formed in alluvium.

Reddish or brownish material of the Loveland Formation, which underlies the Peorian Loess, is the third most extensive parent material in the county. It is commonly believed to be of loessal origin. It is probably older and more oxidized than the Peorian Loess and has slightly more sand. It is as much as 50 feet thick. Most of it is exposed on the lower side slopes along the major drainageways. Some is exposed in small areas along the West Fork of the Big Blue River and along some of the creeks. Geary soils formed in this material.

Deposits of sand and gravel laid down by water during the Quaternary period generally underlie the Loveland Loess. They are exposed in some areas along the West Fork of the Big Blue River and along some of the creeks. The sand and gravel occur only as small areas and as inclusions in the Peoria and Loveland parent materials.

Plant and Animal Life

The soils in Fillmore County formed mainly under tall, mid, and short native grasses. These grasses provided a plentiful supply of organic matter. Their fibrous roots penetrated the soil to a depth of several feet, making it porous and granular. The grasses reduced the runoff rate, thus increasing the amount of moisture available for microbiological activity in the soil. The decay of grass roots improved available water capacity, tilth, and fertility. Over long periods, this decay of organic matter gives the surface layer a dark color.

Micro-organisms feed on undecomposed organic matter and convert it into humus from which plants can obtain nutrients. Bacteria and different kinds of fungi attack leaves and other forms of organic matter. Insects, earthworms, and small burrowing animals help to mix the humus with the soil.

Time

The time needed for the development of genetic horizons depends on the relief, the climate, the kind of plant and animal life, and the kind of parent material. The youngest soils in Fillmore County formed in recently deposited alluvium. They have a dark surface layer, but they show little or no evidence of subsoil development because of the brief amount of time that the parent material has been in place. Hobbs and Muir soils are examples. Muir soils are at the beginning stage of subsoil development. In most areas they formed in alluvium on stream terraces.

The oldest and most extensive soils in the county, which are on uplands, have been in place long enough for the development of fairly thick genetic horizons. The texture of the subsoil is finer than that of the parent material. Hastings, Crete, and Butler are examples of soils that have a well developed subsoil.

Relief

The soils in Fillmore County range from nearly level to steep. The degree of slope and shape of the surface affect the formation of each soil by influencing the amount of runoff and the rate of internal drainage.

Generally, the soil profile is thicker in the less sloping soils and thinner in the more sloping soils. The solum in the moderately steep and steep Uly soils, for example, is thinner than that in the less sloping Hastings soils. Also, the surface layer is lighter colored. Because runoff is more rapid on the steeper slopes, less moisture is available for plant growth and microbiological activity. Also, erosion is more extensive unless the steeper slopes are protected. Lime normally is not leached so deep in the steeper soils as in the less sloping soils.

On the poorly drained or very poorly drained Fillmore, Scott, and Massie silt loams, runoff generally is ponded. The moisture on and in these soils has resulted in a concentration of clay in the subsoil.

Soils on bottom lands, for example, Hobbs soils, generally are nearly level and are occasionally flooded or frequently flooded for brief periods. Each overflow on such soils deposits more soil material.

References

(1) American Association of State Highway [and Transportation] Officials. 1970. Standard specifications for highway materials and methods of sampling and testing. Ed. 10, 2 vols., illus.

(2) American Society for Testing and Materials. 1974. Method for classification of soils for engineering purposes. ASTM Stand. D 2487-69. *In* 1974 Annual Book of ASTM Standards, Part 19, 464 pp., illus.

(3) Condra, G. E., and E. C. Reed. 1959. The geological section of Nebraska. Univ. Nebr. Conserv. and Surv. Div., Nebr. Geol. Surv. Bull. 14A, 82 pp., illus.

(4) Gaffney, W. G., ed. 1968. The Fillmore County story. Geneva Community Grange No. 403, 398 pp., illus.

(5) Meyer, A. H., C. E. Collett, and N. A. Bengston. 1918. Soil survey of Fillmore County, Nebraska. U.S. Dep. Agric., Bur. of Soils, 24 pp., illus.

(6) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus.

(7) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436, 754 pp., illus.

(8) United States Department of Agriculture. 1983. Irrigation guide for Nebraska. Soil Conserv. Serv. Looseleaf

(9) United States Department of the Interior. 1968. Geology and ground-water resources of Fillmore County, Nebraska. Geol. Surv. Water Supply Pap. 1839-L, 27 pp., illus.

Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Catsteps. Very small, irregular terraces on steep hillsides, especially in pasture, formed by the trampling of cattle or the slippage of saturated soil.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of

the soil profile between depths of 10 inches and 40 or 80 inches.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Organic matter. Plant and animal residue in the soil in various stages of decomposition. The classes of organic matter content recognized in this survey are very low, less than 0.5 percent; low, 0.5 to 1.0 percent; moderately low, 1.0 to 2.0 percent; moderate, 2.0 to 4.0 percent; and high, 4.0 to 8.0 percent.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Proper grazing use. The removal of not more than 50 percent, by weight, of the key management plants when an area of range or pasture is grazed. Proper grazing use protects the surface by maintaining an adequate plant cover. It also maintains or improves the quality and quantity of desirable vegetation.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or

browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multipled by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey the classes of slope are—

	Percent
Nearly level	0 to 1 or 0 to 2
Very gently sloping	1 to 3
Gently sloping	3 to 6
Strongly sloping	6 to 11
Moderately steep	11 to 17
Steep	17 to 30

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with

rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Data were recorded in the period 1951-80 at Fairmont, Nebraska]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	33.8	11.2	22.5	60	-16	0	0.46	0.11	0.73	2	6.6
February---	41.3	17.4	29.4	71	-12	17	.77	.20	1.21	2	6.0
March------	50.4	25.9	38.2	82	-4	52	1.68	.37	2.70	4	6.9
April------	65.4	38.7	52.1	88	17	132	2.67	1.33	3.83	6	1.7
May--------	75.5	49.7	62.6	93	29	398	3.66	2.03	5.09	7	.2
June-------	85.6	59.7	72.7	102	42	681	3.84	1.74	5.63	7	.0
July-------	90.0	64.3	77.2	103	49	843	3.02	1.23	4.52	6	.0
August-----	88.1	62.6	75.4	100	47	787	3.37	1.09	5.23	6	.0
September--	80.1	52.8	66.5	98	33	495	3.06	1.04	4.72	5	.0
October----	69.7	41.8	55.8	90	22	216	1.67	.36	2.70	3	.2
November---	52.3	27.8	40.1	74	4	12	.92	.12	1.52	2	2.6
December---	40.4	17.5	29.0	66	-11	0	.59	.17	.92	2	5.1
Yearly:											
Average--	64.4	39.1	51.8	---	---	---	---	---	---	---	---
Extreme--	---	---	---	103	-18	---	---	---	---	---	---
Total----	---	---	---	---	---	3,633	25.71	20.16	30.92	52	29.3

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Data were recorded in the period 1951-80 at Fairmont, Nebraska]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 18	May 1	May 12
2 years in 10 later than--	April 14	April 26	May 6
5 years in 10 later than--	April 6	April 17	April 26
First freezing temperature in fall:			
1 year in 10 earlier than--	October 17	October 10	October 1
2 years in 10 earlier than--	October 21	October 13	October 15
5 years in 10 earlier than--	October 30	October 21	October 13

TABLE 3.--GROWING SEASON

[Data were recorded in the period 1951-80 at Fairmont, Nebraska]

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	189	170	150
8 years in 10	195	176	157
5 years in 10	207	186	170
2 years in 10	218	197	183
1 year in 10	224	203	190

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Bu	Butler silt loam, 0 to 1 percent slopes	45,500	12.3
By	Butler silty clay loam, 0 to 1 percent slopes	1,660	0.4
Ce	Crete silt loam, 0 to 1 percent slopes	100,300	27.2
CeB	Crete silt loam, 1 to 3 percent slopes	64,210	17.4
CeC	Crete silt loam, 3 to 6 percent slopes	1,180	0.3
Cr	Crete silty clay loam, 0 to 1 percent slopes	2,100	0.6
CrB	Crete silty clay loam, 1 to 3 percent slopes	6,550	1.8
CrC2	Crete silty clay loam, 3 to 6 percent slopes, eroded	20,955	5.7
Ct	Crete silt loam, thick solum, 0 to 1 percent slopes	1,970	0.5
Fm	Fillmore silt loam, 0 to 1 percent slopes	10,570	2.9
Fo	Fillmore silt loam, drained, 0 to 1 percent slopes	9,170	2.5
GeC2	Geary silty clay loam, 3 to 6 percent slopes, eroded	540	0.1
GeD2	Geary silty clay loam, 6 to 11 percent slopes, eroded	1,570	0.4
GeE2	Geary silty clay loam, 11 to 17 percent slopes, eroded	270	0.1
GhF	Geary-Hobbs silt loams, 0 to 30 percent slopes	1,620	0.4
Hc	Hastings silt loam, 0 to 1 percent slopes	7,190	1.9
HcB	Hastings silt loam, 1 to 3 percent slopes	22,500	6.1
HcC	Hastings silt loam, 3 to 6 percent slopes	1,420	0.4
HcD	Hastings silt loam, 6 to 11 percent slopes	2,670	0.7
HdC2	Hastings silty clay loam, 3 to 6 percent slopes, eroded	19,000	5.2
HdC3	Hastings silty clay loam, 3 to 6 percent slopes, severely eroded	1,140	0.3
HdD2	Hastings silty clay loam, 6 to 11 percent slopes, eroded	8,090	2.2
He	Hobbs silt loam, 0 to 2 percent slopes	4,370	1.2
Hf	Hobbs silt loam, channeled	6,910	1.9
HhD2	Holder silty clay loam, 6 to 11 percent slopes, eroded	500	0.1
Ke	Kezan silt loam, channeled	1,040	0.3
Ma	Massie silty clay loam, 0 to 1 percent slopes	2,170	0.6
Mu	Muir silt loam, 0 to 1 percent slopes	6,630	1.8
MuB	Muir silt loam, 1 to 3 percent slopes	2,160	0.6
MuC	Muir silt loam, 3 to 6 percent slopes	250	0.1
Ob	Olbut-Butler silt loams, 0 to 1 percent slopes	6,550	1.8
Pt	Pits, gravel	123	*
Sc	Scott silt loam, 0 to 1 percent slopes	2,750	0.8
Sd	Scott silty clay loam, drained, 0 to 1 percent slopes	1,100	0.3
UyE2	Uly silt loam, 11 to 17 percent slopes, eroded	730	0.2
UyF	Uly-Hobbs silt loams, 0 to 30 percent slopes	2,740	0.7
	Water areas less than 40 acres	730	0.2
	Total	368,928	100.0

* Less than 0.1 percent.

TABLE 5.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE

[Yields in the N columns are for nonirrigated soils; those in the I columns are for irrigated soils. Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Land capability		Corn		Grain sorghum		Wheat		Soybeans		Alfalfa hay	
	N	I	N	I	N	I	N	I	N	I	N	I
			Bu	Bu	Bu	Bu	Bu	Bu	Bu	Bu	Tons	Tons
Bu----------------- Butler	IIw	IIw	46	132	63	108	34	---	28	32	3.0	5.4
By----------------- Butler	IIw	IIw	44	130	60	104	32	---	26	30	3.0	5.2
Ce----------------- Crete	IIs	IIs	50	140	68	110	42	---	32	36	3.2	5.8
CeB---------------- Crete	IIe	IIe	48	135	65	105	38	---	28	34	3.0	5.5
CeC---------------- Crete	IIIe	IIIe	45	125	55	102	36	---	26	30	2.5	4.6
Cr----------------- Crete	IIs	IIs	48	138	66	108	40	---	30	34	3.1	5.3
CrB---------------- Crete	IIe	IIe	46	133	63	103	38	---	27	33	2.9	5.3
CrC2--------------- Crete	IIIe	IIIe	43	123	53	100	34	---	24	28	2.3	4.4
Ct----------------- Crete	IIs	IIs	52	142	70	112	43	---	32	38	3.2	5.8
Fm----------------- Fillmore	IIIw	IIIw	34	70	48	100	22	---	---	---	2.2	---
Fo----------------- Fillmore	IIw	IIw	46	130	63	105	34	---	28	32	3.1	5.2
GeC2--------------- Geary	IIIe	IIIe	42	122	56	100	32	---	24	28	2.3	4.5
GeD2--------------- Geary	IVe	IVe	35	92	42	82	24	---	20	22	2.1	4.2
GeE2--------------- Geary	VIe	---	---	---	---	---	---	---	---	---	---	---
GhF---------------- Geary-Hobbs	VIe	---	---	---	---	---	---	---	---	---	---	---
Hc----------------- Hastings	I	I	60	148	74	118	44	---	36	46	3.9	6.0
HcB---------------- Hastings	IIe	IIe	57	145	70	116	40	---	34	44	3.6	6.2
HcC---------------- Hastings	IIIe	IIIe	50	138	62	110	37	---	30	41	2.6	4.8
HcD---------------- Hastings	IVe	IVe	37	94	46	84	26	---	26	34	2.4	4.4
HdC2--------------- Hastings	IIIe	IIIe	42	123	55	100	30	---	24	35	2.3	4.5

TABLE 5.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability		Corn		Grain sorghum		Wheat		Soybeans		Alfalfa hay	
	N	I	N	I	N	I	N	I	N	I	N	I
			Bu	Bu	Bu	Bu	Bu	Bu	Bu	Bu	Tons	Tons
HdC3------------- Hastings	IIIe	IIIe	38	112	48	92	25	---	20	30	1.9	3.8
HdD2------------- Hastings	IVe	IVe	35	92	42	82	24	---	20	30	2.1	4.2
He--------------- Hobbs	IIw	IIw	62	140	70	116	36	---	36	42	3.8	6.5
Hf--------------- Hobbs	VIw	---	---	---	---	---	---	---	---	---	---	---
HhD2------------- Holder	IVe	IVe	35	94	42	85	26	---	20	30	2.3	4.5
Ke--------------- Kezan	Vw	---	---	---	---	---	---	---	---	---	---	---
Ma--------------- Massie	VIIIw	---	---	---	---	---	---	---	---	---	---	---
Mu--------------- Muir	I	I	64	152	80	124	45	---	40	49	4.4	6.5
MuB-------------- Muir	IIe	IIe	62	149	78	120	42	---	38	47	4.2	6.2
MuC-------------- Muir	IIIe	IIIe	55	140	62	110	36	---	30	42	3.2	5.5
Ob--------------- Olbut-Butler	IIIs	IIIs	33	98	54	90	29	---	18	24	2.8	4.5
Pt*-------------- Pits	VIIIs	---	---	---	---	---	---	---	---	---	---	---
Sc--------------- Scott	IVw	---	---	---	25	---	---	---	---	---	---	---
Sd--------------- Scott	IIIw	IIIw	20	65	30	85	14	---	15	20	---	---
UyE2------------- Uly	VIe	---	---	---	---	---	---	---	---	---	---	---
UyF-------------- Uly-Hobbs	VIe	---	---	---	---	---	---	---	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--CAPABILITY CLASSES AND SUBCLASSES

[All soils are assigned to nonirrigated capability subclasses (N). Only potentially irrigable soils are assigned to irrigated subclasses (I). Absence of an entry indicates no acreage]

Class	Total acreage	Major management concerns (Subclass)			
		Erosion (e)	Wetness (w)	Soil problem (s)	Climate (c)
		Acres	Acres	Acres	Acres
I (N)	13,820	---	---	---	---
(I)	13,820	---	---	---	---
II (N)	260,490	95,420	60,700	104,370	---
(I)	260,490	95,420	60,700	104,370	---
III (N)	62,705	44,485	11,670	6,550	---
(I)	62,705	44,485	11,670	6,550	---
IV (N)	15,580	12,830	2,750	---	---
(I)	12,830	12,830	---	---	---
V (N)	1,040	---	1,040	---	---
VI (N)	12,270	5,360	6,910	---	---
VII (N)	---	---	---	---	---
VIII(N)	2,293	---	2,170	123	---

TABLE 7.--PRIME FARMLAND

[Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name]

Map symbol	Soil name
Bu	Butler silt loam, 0 to 1 percent slopes (where drained)*
By	Butler silty clay loam, 0 to 1 percent slopes (where drained)*
Ce	Crete silt loam, 0 to 1 percent slopes
CeB	Crete silt loam, 1 to 3 percent slopes
CeC	Crete silt loam, 3 to 6 percent slopes
Cr	Crete silty clay loam, 0 to 1 percent slopes
CrB	Crete silty clay loam, 1 to 3 percent slopes
CrC2	Crete silty clay loam, 3 to 6 percent slopes, eroded
Ct	Crete silt loam, thick solum, 0 to 1 percent slopes
Fo	Fillmore silt loam, drained, 0 to 1 percent slopes
GeC2	Geary silty clay loam, 3 to 6 percent slopes, eroded
Hc	Hastings silt loam, 0 to 1 percent slopes
HcB	Hastings silt loam, 1 to 3 percent slopes
HcC	Hastings silt loam, 3 to 6 percent slopes
HdC2	Hastings silty clay loam, 3 to 6 percent slopes, eroded
He	Hobbs silt loam, 0 to 2 percent slopes
Mu	Muir silt loam, 0 to 1 percent slopes
MuB	Muir silt loam, 1 to 3 percent slopes
MuC	Muir silt loam, 3 to 6 percent slopes

* These soils generally have been adequately drained, either by the application of drainage measures or through the incidental drainage resulting from farming, roadbuilding, and other kinds of land development.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

[Only the soils that support rangeland vegetation suitable for grazing are listed]

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Bu, By: Butler	Clayey	Favorable	4,500	Big bluestem	30
		Normal	4,100	Little bluestem	20
		Unfavorable	3,700	Switchgrass	10
				Indiangrass	10
				Tall dropseed	5
				Sideoats grama	5
				Porcupinegrass	5
Ce, CeB, CeC, Cr, CrB, CrC2, Ct: Crete	Clayey	Favorable	4,500	Big bluestem	30
		Normal	4,100	Little bluestem	20
		Unfavorable	3,700	Switchgrass	10
				Porcupinegrass	10
				Indiangrass	5
				Western wheatgrass	5
				Tall dropseed	5
				Sideoats grama	5
Fm: Fillmore	Clayey Overflow	Favorable	3,800	Big bluestem	30
		Normal	3,300	Little bluestem	20
		Unfavorable	2,800	Switchgrass	15
				Western wheatgrass	10
				Indiangrass	5
				Sedge	5
				Kentucky bluegrass	5
Fo: Fillmore	Clayey	Favorable	4,100	Big bluestem	20
		Normal	3,600	Switchgrass	15
		Unfavorable	3,200	Western wheatgrass	15
				Little bluestem	10
				Blue grama	10
				Indiangrass	5
				Canada wildrye	5
				Sedge	5
				Kentucky bluegrass	5
GeC2, GeD2, GeE2: Geary	Silty	Favorable	4,800	Big bluestem	35
		Normal	4,400	Little bluestem	20
		Unfavorable	4,000	Indiangrass	10
				Switchgrass	10
				Tall dropseed	5
				Sideoats grama	5
GhF*:					
Geary	Silty	Favorable	4,800	Big bluestem	35
		Normal	4,400	Little bluestem	20
		Unfavorable	4,000	Indiangrass	10
				Switchgrass	10
				Tall dropseed	5
				Sideoats grama	5
Hobbs	Silty Overflow	Favorable	4,000	Big bluestem	40
		Normal	3,800	Switchgrass	15
		Unfavorable	3,500	Little bluestem	10
				Western wheatgrass	10
				Indiangrass	5
				Sedge	5

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production		Characteristic vegetation	Compo-sition
		Kind of year	Dry weight		
			Lb/acre		Pct
Hc, HcB, HcC, HcD, HdC2, HdC3, HdD2-- Hastings	Silty	Favorable	4,800	Big bluestem	30
		Normal	4,400	Little bluestem	25
		Unfavorable	4,000	Switchgrass	10
				Sideoats grama	5
				Indiangrass	5
				Sedge	5
				Porcupinegrass	5
He, Hf Hobbs	Silty Overflow	Favorable	5,000	Big bluestem	40
		Normal	4,300	Switchgrass	15
		Unfavorable	3,500	Little bluestem	10
				Western wheatgrass	10
				Indiangrass	5
				Sedge	5
HhD2 Holder	Silty	Favorable	4,800	Big bluestem	30
		Normal	4,400	Little bluestem	30
		Unfavorable	4,000	Switchgrass	10
				Sideoats grama	5
				Indiangrass	5
				Sedge	5
				Porcupinegrass	5
Ke Kezan	Subirrigated	Favorable	5,900	Big bluestem	35
		Normal	5,500	Little bluestem	20
		Unfavorable	5,100	Switchgrass	10
				Indiangrass	10
				Prairie cordgrass	5
				Canada wildrye	5
				Sedge	5
Mu, MuB, MuC Muir	Silty Lowland	Favorable	5,300	Big bluestem	30
		Normal	4,600	Indiangrass	15
		Unfavorable	3,800	Switchgrass	10
				Little bluestem	5
				Tall dropseed	5
				Eastern gamagrass	5
				Prairie cordgrass	5
				Maximilian sunflower	5
				Wholeleaf rosinweed	5
Ob*:					
Olbut	Saline Lowland	Favorable	2,600	Western wheatgrass	20
		Normal	2,400	Indiangrass	10
		Unfavorable	2,100	Inland saltgrass	10
				Blue grama	10
				Alkali sacaton	5
				Big bluestem	5
				Sedge	5
				Canada wildrye	5
Butler	Clayey	Favorable	4,500	Big bluestem	30
		Normal	4,100	Little bluestem	20
		Unfavorable	3,700	Switchgrass	10
				Indiangrass	10
				Tall dropseed	5
				Sideoats grama	5
				Western wheatgrass	5

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Compo- sition
			Lb/acre		Pct
Sd: Scott	Clayey Overflow	Favorable	2,800	Western wheatgrass	30
		Normal	2,200	Big bluestem	20
		Unfavorable	1,700	Switchgrass	10
				Sedge	10
				Little bluestem	5
				Canada wildrye	5
				Blue grama	5
				Buffalograss	5
UyE2: Uly	Silty	Favorable	3,700	Big bluestem	30
		Normal	3,200	Little bluestem	25
		Unfavorable	2,700	Sideoats grama	10
				Western wheatgrass	10
				Blue grama	5
				Sedge	5
				Switchgrass	5
UyF*:					
Uly	Silty	Favorable	3,700	Big bluestem	30
		Normal	3,200	Little bluestem	25
		Unfavorable	2,700	Sideoats grama	10
				Blue grama	10
				Western wheatgrass	5
				Sedge	5
				Switchgrass	5
Hobbs	Silty Overflow	Favorable	4,000	Big bluestem	40
		Normal	3,800	Switchgrass	15
		Unfavorable	3,500	Little bluestem	10
				Western wheatgrass	10
				Indiangrass	5
				Sedge	5

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Bu, By------------ Butler	Redosier dogwood	American plum, common chokecherry.	Eastern redcedar, Austrian pine, hackberry, blue spruce.	Golden willow, green ash, honeylocust, silver maple.	Eastern cottonwood.
Ce, CeB, CeC, Cr, CrB, CrC2, Ct---- Crete	Lilac, Peking cotoneaster.	Manchurian crabapple, Amur honeysuckle, Siberian peashrub.	Eastern redcedar, hackberry, Russian-olive, green ash, Austrian pine.	Honeylocust, Siberian elm.	---
Fm---------------- Fillmore	Redosier dogwood	Common chokecherry, American plum.	Eastern redcedar, hackberry.	Austrian pine, green ash, honeylocust, silver maple, northern red oak, golden willow.	Eastern cottonwood.
Fo---------------- Fillmore	Lilac, Peking cotoneaster.	Siberian peashrub, Manchurian crabapple, Amur honeysuckle.	Eastern redcedar, hackberry, Russian-olive, Austrian pine, green ash.	Honeylocust, Siberian elm.	---
GeC2, GeD2, GeE2-- Geary	Peking cotoneaster	Lilac, fragrant sumac, Amur honeysuckle.	Eastern redcedar, hackberry, bur oak, green ash, Russian-olive.	Scotch pine, Austrian pine, honeylocust.	---
GhF*: Geary.					
Hobbs------------	---	American plum, Peking cotoneaster, lilac, Amur honeysuckle.	Eastern redcedar	Green ash, hackberry, Austrian pine, honeylocust, eastern white pine, bur oak.	Eastern cottonwood.
Hc, HcB, HcC, HcD, HdC2, HdC3, HdD2- Hastings	Amur honeysuckle, lilac, fragrant sumac.	Russian mulberry	Eastern redcedar, Austrian pine, green ash, honeylocust, hackberry, bur oak, Russian-olive.	Siberian elm------	---
He, Hf------------ Hobbs	---	American plum, Peking cotoneaster, lilac, Amur honeysuckle.	Eastern redcedar	Green ash, hackberry, Austrian pine, honeylocust, eastern white pine, bur oak.	Eastern cottonwood.

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
HhD2------------- Holder	Amur honeysuckle, lilac, fragrant sumac.	Russian mulberry	Eastern redcedar, Austrian pine, green ash, honeylocust, hackberry, bur oak, Russian-olive.	Siberian elm------	---
Ke. Kezan					
Ma. Massie					
Mu, MuB, MuC------ Muir	---	Peking cotoneaster, Amur honeysuckle, American plum, lilac.	Eastern redcedar	Eastern white pine, honey-locust, bur oak, Austrian pine, green ash, hackberry.	Eastern cottonwood.
Ob*: Olbut------------	Siberian peashrub, silver buffaloberry, Tatarian honeysuckle.	Eastern redcedar, Russian-olive.	Austrian pine, honeylocust, green ash.	Siberian elm------	Eastern cottonwood.
Butler-----------	Redosier dogwood	American plum, common chokecherry.	Eastern redcedar, Austrian pine, hackberry, blue spruce.	Golden willow, green ash, honeylocust, silver maple.	Eastern cottonwood.
Pt*. Pits					
Sc. Scott					
Sd--------------- Scott	Redosier dogwood	American plum, common chokecherry.	Eastern redcedar, Austrian pine, hackberry, Russian mulberry.	Golden willow, honeylocust, green ash, silver maple.	Eastern cottonwood.
UyE2------------- Uly	Amur honeysuckle, lilac.	Common chokecherry, Russian mulberry.	Eastern redcedar, green ash, Russian-olive, honeylocust, Austrian pine, hackberry, bur oak.	Siberian elm------	---
UyF*: Uly.					
Hobbs------------	---	American plum, Peking cotoneaster, lilac, Amur honeysuckle.	Eastern redcedar	Green ash, hackberry, Austrian pine, honeylocust, eastern white pine, bur oak.	Eastern cottonwood.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Bu, By: Butler	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Ce: Crete	Slight	Slight	Slight	Slight.
CeB, CeC: Crete	Slight	Slight	Moderate: slope.	Slight.
Cr: Crete	Slight	Slight	Slight	Slight.
CrB, CrC2: Crete	Slight	Slight	Moderate: slope.	Slight.
Ct: Crete	Slight	Slight	Slight	Slight.
Fm: Fillmore	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding.
Fo: Fillmore	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Moderate: wetness.
GeC2: Geary	Slight	Slight	Moderate: slope.	Slight.
GeD2, GeE2: Geary	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
GhF*:				
Geary	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Hobbs	Severe: flooding.	Slight	Moderate: flooding.	Slight.
Hc: Hastings	Slight	Slight	Slight	Slight.
HcB, HcC: Hastings	Slight	Slight	Moderate: slope.	Slight.
HcD: Hastings	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
HdC2, HdC3: Hastings	Slight	Slight	Moderate: slope.	Slight.
HdD2: Hastings	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
He: Hobbs	Severe: flooding.	Slight	Moderate: flooding.	Slight.
Hf: Hobbs	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
HhD2: Holder	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Ke: Kezan	Severe: flooding, wetness.	Moderate: flooding, wetness.	Severe: wetness, flooding.	Moderate: wetness, flooding.
Ma: Massie	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding.
Mu: Muir	Severe: flooding.	Slight	Slight	Slight.
MuB, MuC: Muir	Severe: flooding.	Slight	Moderate: slope.	Slight.
Ob*:				
Olbut	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Butler	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Pt*. Pits				
Sc: Scott	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding.
Sd: Scott	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.
UyE2: Uly	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
UyF*:				
Uly	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Hobbs	Severe: flooding.	Slight	Moderate: flooding.	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Bu, By------------- Butler	Good	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair	Good.
Ce, CeB------------ Crete	Good	Good	Good	Fair	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
CeC---------------- Crete	Fair	Good	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Good.
Cr, CrB------------ Crete	Good	Good	Good	Fair	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
CrC2--------------- Crete	Fair	Good	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Good.
Ct----------------- Crete	Good	Good	Good	Fair	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
Fm----------------- Fillmore	Fair	Good	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Good	Fair.
Fo----------------- Fillmore	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good.
GeC2, GeD2--------- Geary	Fair	Good	Good	Fair	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
GeE2--------------- Geary	Poor	Fair	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Good.
GhF*:												
Geary--------------	Poor	Fair	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Good.
Hobbs--------------	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good.
Hc, HcB------------ Hastings	Good	Good	Good	Good	Good	Good	Very poor.	Poor	Good	Good	Very poor.	Good.
HcC, HcD, HdC2, HdC3, HdD2-------- Hastings	Fair	Good	Good	Good	Fair	Good	Very poor.	Poor	Good	Good	Very poor.	Good.
He----------------- Hobbs	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good.
Hf----------------- Hobbs	Poor	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
HhD2--------------- Holder	Fair	Good	Good	Good	Fair	Fair	Very poor.	Very poor.	Good	Good	Very poor.	Good.
Ke----------------- Kezan	Poor	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good	Fair.
Ma----------------- Massie	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good	Very poor.

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Mu, MuB, MuC-------- Muir	Good	Good	Good	Good	Fair	Good	Poor	Very poor.	Good	Good	Very poor.	Good.
Ob*:												
Olbut-------------	Fair	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair	Good.
Butler------------	Good	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair	Good.
Pt*. Pits												
Sc----------------- Scott	Poor	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good	Fair.
Sd----------------- Scott	Fair	Good	Fair	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
UyE2--------------- Uly	Poor	Fair	Good	Good	Fair	Fair	Very poor.	Very poor.	Fair	Good	Very poor.	Fair.
UyF*:												
Uly---------------	Poor	Fair	Good	Good	Fair	Fair	Very poor.	Very poor.	Poor	Good	Very poor.	Fair.
Hobbs-------------	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Bu, By------------ Butler	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: low strength, wetness, frost action.	Severe: wetness.
Ce, CeB, CeC, Cr, CrB, CrC2, Ct---- Crete	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
Fm---------------- Fillmore	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, low strength, frost action.	Severe: ponding.
Fo---------------- Fillmore	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.
GeC2-------------- Geary	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
GeD2, GeE2-------- Geary	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
GhF*:						
Geary------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope, frost action.	Severe: slope.
Hobbs------------	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
Hc, HcB, HcC------ Hastings	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
HcD--------------- Hastings	Moderate: too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.	Moderate: slope.
HdC2, HdC3-------- Hastings	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
HdD2-------------- Hastings	Moderate: too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.	Moderate: slope.
He---------------- Hobbs	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Hf: Hobbs	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Severe: flooding.
HhD2: Holder	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: frost action, low strength.	Moderate: slope.
Ke: Kezan	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Severe: flooding.
Ma: Massie	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, frost action.	Severe: ponding.
Mu, MuB, MuC: Muir	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.	Slight.
Ob*:						
Olbut	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
Butler	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: low strength, wetness, frost action.	Severe: wetness.
Pt*. Pits						
Sc: Scott	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, frost action.	Severe: ponding.
Sd: Scott	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, wetness, frost action.	Severe: wetness.
UyE2: Uly	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength.	Moderate: slope.
UyF*:						
Uly	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
Hobbs	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Bu, By: Butler	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: hard to pack, wetness.
Ce: Crete	Severe: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight	Poor: hard to pack.
CeB, CeC: Crete	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Poor: hard to pack.
Cr: Crete	Severe: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight	Poor: hard to pack.
CrB, CrC2: Crete	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Poor: hard to pack.
Ct: Crete	Severe: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight	Poor: hard to pack.
Fm: Fillmore	Severe: percs slowly, ponding.	Severe: ponding.	Severe: too clayey, ponding.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
Fo: Fillmore	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
GeC2: Geary	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
GeD2, GeE2: Geary	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
GhF*:					
Geary	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Hobbs	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
Hc: Hastings	Severe: percs slowly.	Moderate: seepage.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
HcB, HcC: Hastings	Severe: percs slowly.	Moderate: seepage, slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
HcD: Hastings	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
HdC2, HdC3----------- Hastings	Severe: percs slowly.	Moderate: seepage, slope.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
HdD2----------------- Hastings	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
He, Hf--------------- Hobbs	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
HhD2----------------- Holder	Moderate: slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: slope, too clayey.
Ke------------------- Kezan	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
Ma------------------- Massie	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
Mu------------------- Muir	Moderate: flooding.	Moderate: seepage.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
MuB, MuC------------- Muir	Moderate: flooding.	Moderate: seepage, slope.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
Ob*:					
Olbut----------------	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: hard to pack, ponding.
Butler---------------	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: hard to pack, wetness.
Pt*. Pits					
Sc------------------- Scott	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
Sd------------------- Scott	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
UyE2----------------- Uly	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
UyF*:					
Uly------------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Hobbs----------------	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Bu, By----------------- Butler	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
Ce, CeB, CeC, Cr, CrB, CrC2, Ct------------- Crete	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Fm-------------------- Fillmore	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, thin layer.
Fo-------------------- Fillmore	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
GeC2------------------ Geary	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
GeD2, GeE2------------ Geary	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
GhF*:				
Geary-----------------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Hobbs-----------------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Hc, HcB, HcC, HcD, HdC2, HdC3, HdD2----- Hastings	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
He, Hf---------------- Hobbs	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
HhD2------------------ Holder	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, too clayey.
Ke-------------------- Kezan	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: wetness.
Ma-------------------- Massie	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Mu, MuB, MuC---------- Muir	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Ob*:				
Olbut-----------------	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ob*:				
Butler	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
Pt*. Pits				
Sc, Sd Scott	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
UyE2 Uly	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
UyF*:				
Uly	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Hobbs	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
Bu, By: Butler	Moderate: seepage.	Severe: wetness.	Percs slowly, frost action.	Wetness, percs slowly, erodes easily.	Erodes easily, wetness.	Wetness, erodes easily, percs slowly.
Ce, CeB: Crete	Moderate: seepage.	Moderate: hard to pack.	Deep to water	Percs slowly, erodes easily.	Erodes easily	Erodes easily, percs slowly.
CeC: Crete	Moderate: seepage, slope.	Moderate: hard to pack.	Deep to water	Percs slowly, slope, erodes easily.	Erodes easily	Erodes easily, percs slowly.
Cr, CrB: Crete	Moderate: seepage.	Moderate: hard to pack.	Deep to water	Percs slowly, erodes easily.	Erodes easily	Erodes easily, percs slowly.
CrC2: Crete	Moderate: seepage, slope.	Moderate: hard to pack.	Deep to water	Percs slowly, slope, erodes easily.	Erodes easily	Erodes easily, percs slowly.
Ct: Crete	Moderate: seepage.	Moderate: hard to pack.	Deep to water	Percs slowly, erodes easily.	Erodes easily	Erodes easily, percs slowly.
Fm: Fillmore	Moderate: seepage.	Severe: hard to pack, ponding.	Percs slowly, frost action, ponding.	Percs slowly, ponding, erodes easily.	Erodes easily, ponding, percs slowly.	Wetness, erodes easily, percs slowly.
Fo: Fillmore	Moderate: seepage.	Severe: hard to pack.	Percs slowly, frost action.	Wetness, percs slowly, erodes easily.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
GeC2: Geary	Moderate: seepage, slope.	Slight	Deep to water	Slope	Erodes easily	Erodes easily.
GeD2, GeE2: Geary	Severe: slope.	Slight	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
GhF*:						
Geary	Severe: slope.	Slight	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Hobbs	Moderate: seepage.	Severe: piping.	Deep to water	Flooding	Favorable	Favorable.
Hc, HcB: Hastings	Moderate: seepage.	Moderate: hard to pack.	Deep to water	Favorable	Erodes easily	Erodes easily.
HcC: Hastings	Moderate: seepage, slope.	Moderate: hard to pack.	Deep to water	Slope	Erodes easily	Erodes easily.
HcD: Hastings	Severe: slope.	Moderate: hard to pack.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
HdC2, HdC3: Hastings	Moderate: seepage, slope.	Moderate: hard to pack.	Deep to water	Slope	Erodes easily	Erodes easily.

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
HdD2 Hastings	Severe: slope.	Moderate: hard to pack.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
He, Hf Hobbs	Moderate: seepage.	Severe: piping.	Deep to water	Flooding	Favorable	Favorable.
HhD2 Holder	Severe: slope.	Severe: piping.	Deep to water	Slope	Erodes easily, slope.	Slope, erodes easily.
Ke Kezan	Moderate: seepage.	Severe: piping, wetness.	Flooding, frost action.	Wetness, flooding.	Wetness	Wetness.
Ma Massie	Slight	Severe: hard to pack, ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Erodes easily, ponding, percs slowly.	Wetness, percs slowly.
Mu, MuB Muir	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Favorable	Favorable.
MuC Muir	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Favorable	Favorable.
Ob*: Olbut	Moderate: seepage.	Severe: ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly, erodes easily.	Erodes easily, ponding.	Wetness, erodes easily, percs slowly.
Butler	Moderate: seepage.	Severe: wetness.	Percs slowly, frost action.	Wetness, percs slowly, erodes easily.	Erodes easily, wetness.	Wetness, erodes easily, percs slowly.
Pt*. Pits						
Sc Scott	Moderate: seepage.	Severe: hard to pack, ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly, erodes easily.	Not needed	Not needed.
Sd Scott	Moderate: seepage.	Severe: hard to pack, wetness.	Wetness, percs slowly, frost action.	Wetness, percs slowly, erodes easily.	Not needed	Not needed.
UyE2 Uly	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
UyF*: Uly	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Hobbs	Moderate: seepage.	Severe: piping.	Deep to water	Flooding	Favorable	Favorable.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Bu---------------- Butler	0-13	Silt loam--------	CL-ML, CL	A-4, A-7, A-6	0	100	100	100	95-100	20-45	5-20
	13-29	Clay, silty clay	CH	A-7	0	100	100	100	95-100	50-70	30-45
	29-34	Silty clay loam, silty clay.	CL, CH	A-6, A-7	0	100	100	100	95-100	35-60	15-35
	34-60	Silt loam, silty clay loam.	CL, CH	A-4, A-6, A-7	0	100	100	100	95-100	30-60	10-35
By---------------- Butler	0-4	Silty clay loam	CL	A-4, A-6	0	100	100	100	95-100	30-40	5-15
	4-20	Silty clay-------	CH	A-7	0	100	100	100	95-100	50-70	30-45
	20-28	Silty clay loam, silty clay.	CL, CH	A-6, A-7	0	100	100	100	95-100	35-60	15-35
	28-60	Silt loam, silty clay loam.	CL, CH	A-6, A-7	0	100	100	100	95-100	30-60	10-35
Ce, CeB, CeC------ Crete	0-12	Silt loam--------	CL, ML	A-4, A-6	0	100	100	100	95-100	30-40	5-15
	12-33	Silty clay-------	CH	A-7	0	100	100	100	95-100	50-75	25-45
	33-60	Silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	100	95-100	30-55	10-35
Cr, CrB----------- Crete	0-6	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-30
	6-18	Silty clay-------	CH	A-7	0	100	100	100	95-100	50-65	25-40
	18-60	Silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	100	95-100	30-55	10-35
CrC2-------------- Crete	0-5	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	33-50	10-30
	5-22	Silty clay-------	CH	A-7	0	100	100	100	95-100	50-65	25-40
	22-60	Silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	100	95-100	30-55	10-35
Ct---------------- Crete	0-19	Silt loam--------	CL, ML	A-4, A-6	0	100	100	100	95-100	30-40	5-15
	19-50	Silty clay-------	CH	A-7	0	100	100	100	95-100	50-65	25-40
	50-60	Silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	100	95-100	30-55	10-35
Fm, Fo------------ Fillmore	0-14	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	100	95-100	20-40	2-20
	14-55	Silty clay-------	CH, CL	A-7	0	100	100	100	95-100	40-75	20-45
	55-60	Silt loam, silty clay loam, silty clay.	CL, CH	A-6, A-7	0	100	100	100	95-100	25-75	10-45
GeC2, GeD2, GeE2- Geary	0-6	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	75-98	35-45	15-25
	6-30	Silty clay loam, clay loam.	CL	A-7, A-6	0	100	100	96-100	85-98	35-50	15-25
	30-60	Silty clay loam, clay loam, silt loam.	CL	A-6, A-7	0	100	100	96-100	85-98	30-45	11-22
GhF*:											
Geary------------	0-6	Silt loam--------	ML, CL	A-4, A-6	0	100	100	96-100	80-98	25-40	2-15
	6-36	Silty clay loam, clay loam.	CL	A-7, A-6	0	100	100	96-100	85-98	35-50	15-25
	36-60	Silty clay loam, clay loam, silt loam.	CL	A-6, A-7	0	100	100	96-100	85-98	30-45	11-22

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
GhF*:											
Hobbs-----------	0-8	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-20
	8-60	Sandy loam, silty clay loam, very fine sandy loam.	CL, CL-ML, MH	A-4, A-6, A-7	0	100	100	95-100	80-100	25-55	5-25
Hc, HcB, HcC, HcD Hastings	0-7	Silt loam--------	CL, CL-ML	A-6, A-4	0	100	100	100	95-100	25-40	5-15
	7-35	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	40-65	20-40
	35-60	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	100	95-100	30-50	10-25
HdC2, HdC3, HdD2- Hastings	0-7	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	30-45	10-25
	7-31	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	40-65	20-40
	31-60	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	100	95-100	30-50	10-25
He, Hf----------- Hobbs	0-9	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-20
	9-60	Silty clay loam, very fine sandy loam.	CL, CL-ML, MH	A-4, A-6, A-7	0	100	100	95-100	80-100	25-55	5-25
HhD2------------- Holder	0-5	Silty clay loam	CL	A-7, A-6	0	100	100	98-100	95-100	35-50	20-35
	5-18	Silty clay loam	CL	A-6, A-7	0	100	100	98-100	95-100	35-50	20-35
	18-60	Silt loam, silty clay loam.	CL, ML	A-4, A-6, A-7	0	100	100	95-100	90-100	30-45	5-20
Ke--------------- Kezan	0-5	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	95-100	70-90	20-35	2-12
	5-60	Silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	95-100	80-95	20-40	4-20
Ma--------------- Massie	0-8	Silty clay loam	CL	A-4, A-6, A-7	0	100	100	100	95-100	22-45	8-25
	8-60	Silty clay, clay, silty clay loam.	CL, CH	A-7	0	100	100	100	95-100	45-70	20-45
Mu, MuB, MuC----- Muir	0-15	Silt loam--------	CL, ML, CL-ML	A-4, A-6	0	100	100	95-100	85-100	20-35	4-15
	15-60	Silt loam, silty clay loam, loam.	CL, ML, CL-ML	A-4, A-6, A-7-6	0	100	100	95-100	85-100	20-45	4-20
Ob*:											
Olbut-----------	0-7	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	20-40	5-18
	7-32	Silty clay-------	CH	A-7	0	100	100	100	95-100	50-65	30-45
	32-40	Silty clay loam, silt loam, silty clay.	CL, CH	A-6, A-7	0	100	100	100	95-100	30-60	10-35
	40-60	Silt loam, silty clay loam.	CL, CH	A-6, A-7	0	100	100	100	95-100	30-60	10-35
Butler----------	0-10	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	20-40	5-15
	10-29	Silty clay-------	CH	A-7	0	100	100	100	95-100	50-70	30-45
	29-36	Silty clay loam, silty clay.	CL, CH	A-6, A-7	0	100	100	100	95-100	35-60	15-35
	36-60	Silt loam, silty clay loam.	CL, CH	A-6, A-7	0	100	100	100	95-100	30-60	10-35
Pt*. Pits											

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Sc---------------- Scott	0-5	Silt loam--------	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	100	95-100	20-45	2-20
	5-40	Silty clay-------	CH, CL	A-7	0	100	100	100	95-100	41-75	20-45
	40-60	Silty clay loam, silty clay.	CL, CH	A-7, A-6	0	100	100	100	95-100	35-60	20-40
Sd---------------- Scott	0-5	Silty clay loam	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	100	95-100	20-45	2-20
	5-50	Silty clay, clay	CH, CL	A-7	0	100	100	100	95-100	41-75	20-45
	50-60	Silty clay loam	CL, CH	A-7, A-6	0	100	100	100	95-100	35-60	20-40
UyE2------------- Uly	0-9	Silt loam--------	ML, CL	A-4, A-6	0	100	100	100	95-100	25-40	2-15
	9-15	Silt loam, silty clay loam.	ML, CL	A-4, A-6	0	100	100	100	95-100	25-40	3-15
	15-60	Silt loam, very fine sandy loam.	CL, ML	A-4, A-6	0	100	100	100	95-100	25-40	3-15
UyF*:											
Uly--------------	0-6	Silt loam--------	ML, CL	A-4, A-6	0	100	100	100	95-100	25-40	2-15
	6-20	Silt loam, silty clay loam.	ML, CL	A-4, A-6	0	100	100	100	95-100	25-40	3-15
	20-60	Silt loam, very fine sandy loam.	CL, ML	A-4, A-6	0	100	100	100	95-100	25-40	3-15
Hobbs------------	0-17	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-20
	17-60	Sandy loam, silty clay loam, very fine sandy loam.	CL, CL-ML, MH	A-4, A-6, A-7	0	100	100	95-100	80-100	25-55	5-25

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Bu----------------	0-13	16-35	1.20-1.40	0.6-2.0	0.20-0.22	5.1-7.3	<2	Moderate	0.37	4	6	2-4
Butler	13-29	45-55	1.10-1.20	0.06-0.2	0.11-0.13	5.6-8.4	<2	High------	0.37			
	29-34	32-45	1.10-1.30	0.2-0.6	0.14-0.20	6.6-8.4	<2	High------	0.37			
	34-60	20-35	1.20-1.40	0.6-2.0	0.18-0.22	6.6-8.4	<2	Moderate	0.37			
By----------------	0-4	18-35	1.20-1.40	0.2-0.6	0.20-0.22	5.1-7.3	<2	Moderate	0.37	4	6	2-4
Butler	4-20	45-55	1.10-1.20	0.06-0.2	0.11-0.13	5.6-8.4	<2	High------	0.37			
	20-28	32-45	1.10-1.30	0.2-0.6	0.14-0.20	6.6-8.4	<2	High------	0.37			
	28-60	20-35	1.20-1.40	0.6-2.0	0.18-0.22	6.6-8.4	<2	Moderate	0.37			
Ce, CeB, CeC-----	0-12	20-27	1.20-1.40	0.6-2.0	0.22-0.24	5.1-6.0	<2	Moderate	0.37	4	6	2-4
Crete	12-33	42-52	1.10-1.30	0.06-0.6	0.12-0.20	6.1-7.8	<2	High------	0.37			
	33-60	25-40	1.20-1.40	0.2-2.0	0.18-0.22	7.4-8.4	<2	High------	0.37			
Cr, CrB----------	0-6	27-35	1.20-1.40	0.2-0.6	0.21-0.23	5.1-6.0	<2	High------	0.37	4	7	2-4
Crete	6-18	42-52	1.10-1.30	0.06-0.6	0.12-0.20	6.1-7.8	<2	High------	0.37			
	18-60	25-40	1.20-1.40	0.2-2.0	0.18-0.22	7.4-8.4	<2	High------	0.37			
CrC2-------------	0-5	27-35	1.20-1.40	0.2-0.6	0.21-0.23	5.1-6.0	<2	High------	0.37	4	7	.5-1
Crete	5-22	42-52	1.10-1.30	0.06-0.6	0.12-0.20	6.1-7.8	<2	High------	0.37			
	22-60	25-40	1.20-1.40	0.2-2.0	0.18-0.22	7.4-8.4	<2	High------	0.37			
Ct----------------	0-19	20-27	1.20-1.40	0.6-2.0	0.22-0.24	5.1-6.0	<2	Moderate	0.37	4	6	.5-1
Crete	19-50	42-52	1.10-1.30	0.06-0.6	0.12-0.20	6.1-7.8	<2	High------	0.37			
	50-60	25-40	1.20-1.40	0.2-2.0	0.18-0.22	7.4-8.4	<2	High------	0.37			
Fm, Fo-----------	0-14	18-35	1.30-1.40	0.6-2.0	0.22-0.24	5.1-6.5	<2	Moderate	0.37	4	6	2-4
Fillmore	14-55	40-55	1.30-1.50	<0.06	0.11-0.14	5.6-7.8	<2	High------	0.37			
	55-60	18-45	1.30-1.50	0.06-2.0	0.10-0.22	6.6-8.4	<2	Moderate	0.37			
GeC2, GeD2, GeE2-	0-6	27-35	1.30-1.40	0.2-0.6	0.18-0.23	5.6-6.5	<2	Moderate	0.32	5	6	.5-1
Geary	6-30	27-35	1.35-1.50	0.6-2.0	0.17-0.20	5.6-7.8	<2	Moderate	0.43			
	30-60	20-32	1.30-1.40	0.6-2.0	0.15-0.19	6.1-8.4	<2	Moderate	0.43			
GhF*:												
Geary-----------	0-6	15-27	1.30-1.40	0.6-2.0	0.22-0.24	5.6-6.5	<2	Low-------	0.32	5	6	2-4
	6-36	27-35	1.35-1.50	0.6-2.0	0.17-0.20	5.6-7.8	<2	Moderate	0.43			
	36-60	20-32	1.30-1.40	0.6-2.0	0.15-0.19	6.1-8.4	<2	Moderate	0.43			
Hobbs-----------	0-8	15-30	1.20-1.40	0.6-2.0	0.21-0.24	6.1-7.8	<2	Low-------	0.32	5	6	2-4
	8-60	15-30	1.20-1.40	0.6-2.0	0.18-0.22	6.1-8.4	<2	Low-------	0.32			
Hc, HcB, HcC, HcD	0-7	15-25	1.20-1.40	0.6-2.0	0.22-0.24	5.6-6.5	<2	Moderate	0.32	5	6	2-4
Hastings	7-35	35-42	1.30-1.40	0.2-0.6	0.11-0.20	5.6-7.3	<2	High------	0.43			
	35-60	25-38	1.20-1.40	0.6-2.0	0.18-0.22	6.1-8.4	<2	Moderate	0.43			
HdC2, HdC3, HdD2-	0-7	28-35	1.20-1.40	0.2-0.6	0.21-0.23	5.6-6.5	<2	Moderate	0.32	5	7	.5-1
Hastings	7-31	35-42	1.30-1.40	0.2-0.6	0.11-0.20	5.6-7.3	<2	High------	0.43			
	31-60	25-38	1.20-1.40	0.6-2.0	0.18-0.22	6.1-8.4	<2	Moderate	0.43			
He, Hf-----------	0-9	15-30	1.20-1.40	0.6-2.0	0.21-0.24	6.1-7.8	<2	Low-------	0.32	5	6	2-4
Hobbs	9-60	15-30	1.20-1.40	0.6-2.0	0.18-0.22	6.1-8.4	<2	Low-------	0.32			
HhD2-------------	0-5	28-35	1.30-1.50	0.6-2.0	0.21-0.23	5.1-7.3	<2	Moderate	0.32	5	7	.5-1
Holder	5-18	28-35	1.20-1.40	0.6-2.0	0.18-0.20	6.1-7.8	<2	Moderate	0.43			
	18-60	15-30	1.40-1.60	0.6-2.0	0.20-0.22	6.6-8.4	<2	Moderate	0.43			

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Ke---------------	0-5	20-27	1.20-1.40	0.6-2.0	0.22-0.24	6.1-7.8	<2	Low--------	0.32	5	6	2-4
Kezan	5-60	20-35	1.20-1.40	0.6-2.0	0.18-0.22	6.1-8.4	<2	Low--------	0.32			
Ma---------------	0-8	15-40	1.40-1.50	0.2-2.0	0.21-0.24	5.1-6.5	<2	Moderate	0.37	5	6	4-8
Massie	8-60	35-55	1.20-1.40	<0.06	0.09-0.20	5.6-7.8	<2	High-------	0.37			
Mu, MuB, MuC-----	0-15	18-27	1.30-1.45	0.6-2.0	0.20-0.23	5.6-7.8	<2	Low--------	0.32	5	6	2-4
Muir	15-60	18-35	1.30-1.50	0.6-2.0	0.18-0.22	6.1-8.4	<2	Low--------	0.32			
Ob*:												
Olbut-----------	0-7	20-32	1.20-1.30	0.6-2.0	0.18-0.20	6.1-7.8	2-4	Moderate	0.37	5	6	1-2
	7-32	40-55	1.30-1.40	0.06-0.2	0.10-0.13	6.1-8.4	4-8	High-------	0.37			
	32-40	20-40	1.30-1.40	0.2-0.6	0.12-0.20	7.4-8.4	4-8	High-------	0.37			
	40-60	20-25	1.20-1.40	0.6-2.0	0.18-0.20	7.9-9.0	2-4	Moderate	0.37			
Butler----------	0-10	18-35	1.20-1.40	0.6-2.0	0.20-0.22	5.1-7.3	<2	Moderate	0.37	4	6	2-4
	10-29	45-55	1.10-1.20	0.06-0.2	0.11-0.13	5.6-8.4	<2	High-------	0.37			
	29-36	32-45	1.10-1.30	0.2-0.6	0.14-0.20	6.6-8.4	<2	High-------	0.37			
	36-60	20-35	1.20-1.40	0.6-2.0	0.18-0.22	6.6-8.4	<2	Moderate	0.37			
Pt*. Pits												
Sc---------------	0-5	15-35	1.25-1.40	0.6-2.0	0.21-0.24	5.1-7.3	<2	Low--------	0.37	3	6	2-4
Scott	5-40	40-55	1.20-1.40	<0.06	0.10-0.14	5.6-7.8	<2	High-------	0.37			
	40-60	27-55	1.15-1.40	0.2-0.6	0.18-0.20	6.6-7.8	<2	High-------	0.37			
Sd---------------	0-5	15-35	1.25-1.40	0.6-2.0	0.21-0.24	5.6-7.3	<2	Low--------	0.37	3	6	2-4
Scott	5-50	40-55	1.20-1.40	<0.06	0.10-0.14	5.6-7.8	<2	High-------	0.37			
	50-60	27-40	1.15-1.40	0.2-0.6	0.18-0.20	6.6-7.8	<2	High-------	0.37			
UyE2-------------	0-9	17-27	1.20-1.30	0.6-2.0	0.20-0.24	6.1-7.8	<2	Low--------	0.32	5	6	.5-1
Uly	9-15	20-30	1.20-1.30	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low--------	0.43			
	15-60	18-27	1.10-1.20	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low--------	0.43			
UyF*:												
Uly--------------	0-6	17-27	1.20-1.30	0.6-2.0	0.20-0.24	6.1-7.8	<2	Low--------	0.32	5	6	1-3
	6-20	20-30	1.20-1.30	0.6-2.0	0.18-0.22	6.1-8.4	<2	Low--------	0.43			
	20-60	18-27	1.10-1.20	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low--------	0.43			
Hobbs-----------	0-17	15-30	1.20-1.40	0.6-2.0	0.21-0.24	6.1-7.8	<2	Low--------	0.32	5	6	2-4
	17-60	15-30	1.20-1.40	0.6-2.0	0.18-0.22	6.1-8.4	<2	Low--------	0.32			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
Bu, By----------- Butler	D	None--------	---	---	0.5-3.0	Perched	Mar-Jul	High-----	High-----	Low.
Ce, CeB, CeC, Cr, CrB, CrC2, Ct---- Crete	C	None--------	---	---	>6.0	---	---	Moderate	Moderate	Low.
Fm--------------- Fillmore	D	None--------	---	---	+.5-1.0	Perched	Mar-Jul	High-----	High-----	Low.
Fo--------------- Fillmore	D	None--------	---	---	1.0-3.0	Perched	Mar-Jul	High-----	High-----	Low.
GeC2, GeD2, GeE2-- Geary	B	None--------	---	---	>6.0	---	---	High-----	Low------	Low.
GhF*:										
Geary-----------	B	None--------	---	---	>6.0	---	---	High-----	Low------	Low.
Hobbs-----------	B	Occasional	Brief-----	Apr-Sep	>6.0	---	---	Moderate	Low------	Low.
Hc, HcB, HcC, HcD, HdC2, HdC3, HdD2- Hastings	B	None--------	---	---	>6.0	---	---	Moderate	Moderate	Low.
He--------------- Hobbs	B	Occasional	Brief-----	Apr-Sep	>6.0	---	---	Moderate	Low------	Low.
Hf--------------- Hobbs	B	Frequent----	Brief-----	Apr-Sep	>6.0	---	---	Moderate	Low------	Low.
HhD2------------- Holder	B	None--------	---	---	>6.0	---	---	High-----	Low------	Low.
Ke--------------- Kezan	D	Frequent----	Brief-----	Mar-Jul	1.0-2.0	Apparent	Nov-Jun	High-----	High-----	Low.
Ma--------------- Massie	D	None--------	---	---	+2-1.0	Perched	Mar-Aug	High-----	High-----	Low.
Mu, MuB, MuC------ Muir	B	Rare--------	---	---	>6.0	---	---	Moderate	Low------	Moderate.
Ob*:										
Olbut-----------	D	None--------	---	---	+.5-3.0	Perched	Mar-Jul	High-----	High-----	High.
Butler----------	D	None--------	---	---	0.5-3.0	Perched	Mar-Jul	High-----	High-----	Low.
Pt*. Pits										
Sc--------------- Scott	D	None--------	---	---	+.5-1.0	Perched	Mar-Aug	High-----	High-----	Low.
Sd--------------- Scott	D	None--------	---	---	.5-2.0	Perched	Mar-Aug	High-----	High-----	Low.

See footnote at end of table.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
UyE2: Uly	B	None	---	---	>6.0	---	---	Moderate	High	Low.
UyF*:										
Uly	B	None	---	---	>6.0	---	---	Moderate	High	Low.
Hobbs	B	Occasional	Brief	Apr-Sep	>6.0	---	---	Moderate	Low	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 19.--ENGINEERING INDEX TEST DATA

[Dashes indicate data were not available. LL means liquid limit and PI means plasticity index]

Soil name*, report number, horizon, and depth in inches	Classification		Grain-size distribution				LL	PI	Specific gravity
	AASHTO	Unified	Percentage passing sieve No. 200	Percentage smaller than-- .05 mm	.005 mm	.002 mm			
							Pct		g/cc
Butler silt loam: (S80NE59-3)									
Ap--- 0 to 10	A-7-6(12)	CL	100	98	---	25	43	18	2.56
Bt1-- 12 to 18	A-7-6(27)	CH	99	95	---	47	70	42	2.63
C---- 40 to 60	A-4(8)	CL	99	92	---	20	34	9	2.66
Crete silt loam: (S79NE59-9)									
Ap--- 0 to 7	A-6(8)	CL	99	94	32	22	35	11	2.59
Bt2-- 16 to 24	A-7-6(28)	CH	99	96	56	48	71	44	2.68
BC--- 33 to 43	A-7-6(17)	CH	99	94	40	30	51	26	2.67
Fillmore silt loam: (S79NE59-8)									
A---- 0 to 7	A-5(8)	CL	99	92	21	13	41	6	2.52
Bt2-- 25 to 36	A-7-6(21)	CH	99	96	51	42	58	34	2.68
Bt3-- 36 to 55	A-7-6(18)	CH	99	95	47	38	52	29	2.67
Hastings silt loam: (S80NE59-17)									
Ap--- 0 to 7	A-6(8)	CL	99	92	---	24	34	11	2.59
Bt2-- 20 to 28	A-7-6(22)	CH	99	94	---	36	61	35	2.67
C2--- 45 to 60	A-6(10)	CL	99	92	---	16	40	16	2.66
Muir silt loam: (S80NE59-15)									
Ap--- 0 to 7	A-4(8)	CL	95	86	---	14	31	7	2.57
Bw2-- 24 to 36	A-6(10)	CL	99	93	---	23	39	16	2.62
Ab--- 48 to 60	A-6(8)	CL	97	91	---	19	32	11	2.60
Scott silt loam: (S79NE59-7)									
Bt2-- 11 to 25	A-7-6(22)	CH	99	96	46	41	58	37	2.66
Bt3-- 25 to 32	A-7-6(23)	CH	99	93	48	42	59	37	2.65
BC1-- 40 to 47	A-7-6(21)	CH	99	95	46	39	57	35	2.67

* Locations of the sampled pedons are as follows:

Butler silt loam, 0 to 1 percent slopes: 1,580 feet east and 180 feet north of the southwest corner of sec. 4, T. 5. N., R. 3 W.
Crete silt loam, 0 to 1 percent slopes: 2,110 feet south and 100 feet west of the northeast corner of sec. 15, T. 5. N., R. 4 W.
Fillmore silt loam, 0 to 1 percent slopes: 325 feet north and 135 feet east of the southwest corner of sec. 19, T. 6 N., R. 4 W.
Hastings silt loam, 1 to 3 percent slopes: 2,320 feet west and 126 feet north of the southeast corner of sec. 11, T. 8 N., R. 4 W.
Muir silt loam, 0 to 1 percent slopes: 2,220 feet west and 90 feet south of the northeast corner of sec. 5, T. 6 N., R. 1 W.
Scott silt loam, 0 to 1 percent slopes: 2,433 feet east and 252 feet south of the northwest corner of sec. 21, T. 5 N., R. 4 W.

TABLE 20.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series]

Soil name	Family or higher taxonomic class
Butler	Fine, montmorillonitic, mesic Abruptic Argiaquolls
Crete	Fine, montmorillonitic, mesic Pachic Argiustolls
Fillmore	Fine, montmorillonitic, mesic Typic Argialbolls
Geary	Fine-silty, mixed, mesic Udic Argiustolls
Hastings	Fine, montmorillonitic, mesic Udic Argiustolls
Hobbs	Fine-silty, mixed, nonacid, mesic Mollic Ustifluvents
Holder	Fine-silty, mixed, mesic Udic Argiustolls
Kezan	Fine-silty, mixed, nonacid, mesic Mollic Fluvaquents
Massie	Fine, montmorillonitic, mesic Typic Argialbolls
Muir	Fine-silty, mixed, mesic Cumulic Haplustolls
Olbut	Fine, montmorillonitic, mesic Abruptic Argiaquolls
Scott	Fine, montmorillonitic, mesic Typic Argialbolls
*Uly	Fine-silty, mixed, mesic Typic Haplustolls

Interpretive Groups

INTERPRETIVE GROUPS

[Dashes indicate that the soil was not placed in the interpretive group]

Soil name and map symbol	Land capability* N	Land capability* I	Prime farmland*	Range site	Windbreak suitability group
Bu: Butler	IIw	IIw	Yes**	Clayey	2W
By: Butler	IIw	IIw	Yes**	Clayey	2W
Ce: Crete	IIs	IIs	Yes	Clayey	4L
CeB: Crete	IIe	IIe	Yes	Clayey	4L
CeC: Crete	IIIe	IIIe	Yes	Clayey	4L
Cr: Crete	IIs	IIs	Yes	Clayey	4L
CrB: Crete	IIe	IIe	Yes	Clayey	4L
CrC2: Crete	IIIe	IIIe	Yes	Clayey	4L
Ct: Crete	IIs	IIs	Yes	Clayey	4L
Fm: Fillmore	IIIw	IIIw	---	Clayey Overflow	2W
Fo: Fillmore	IIw	IIw	Yes	Clayey	2W
GeC2: Geary	IIIe	IIIe	Yes	Silty	3
GeD2: Geary	IVe	IVe	---	Silty	3
GeE2: Geary	VIe	---	---	Silty	3
GhF:	VIe	---	---		
Geary				Silty	10
Hobbs				Silty Overflow	1
Hc: Hastings	I	I	Yes	Silty	3
HcB: Hastings	IIe	IIe	Yes	Silty	3
HcC: Hastings	IIIe	IIIe	Yes	Silty	3
HcD: Hastings	IVe	IVe	---	Silty	3
HdC2: Hastings	IIIe	IIIe	Yes	Silty	3

See footnotes at end of table.

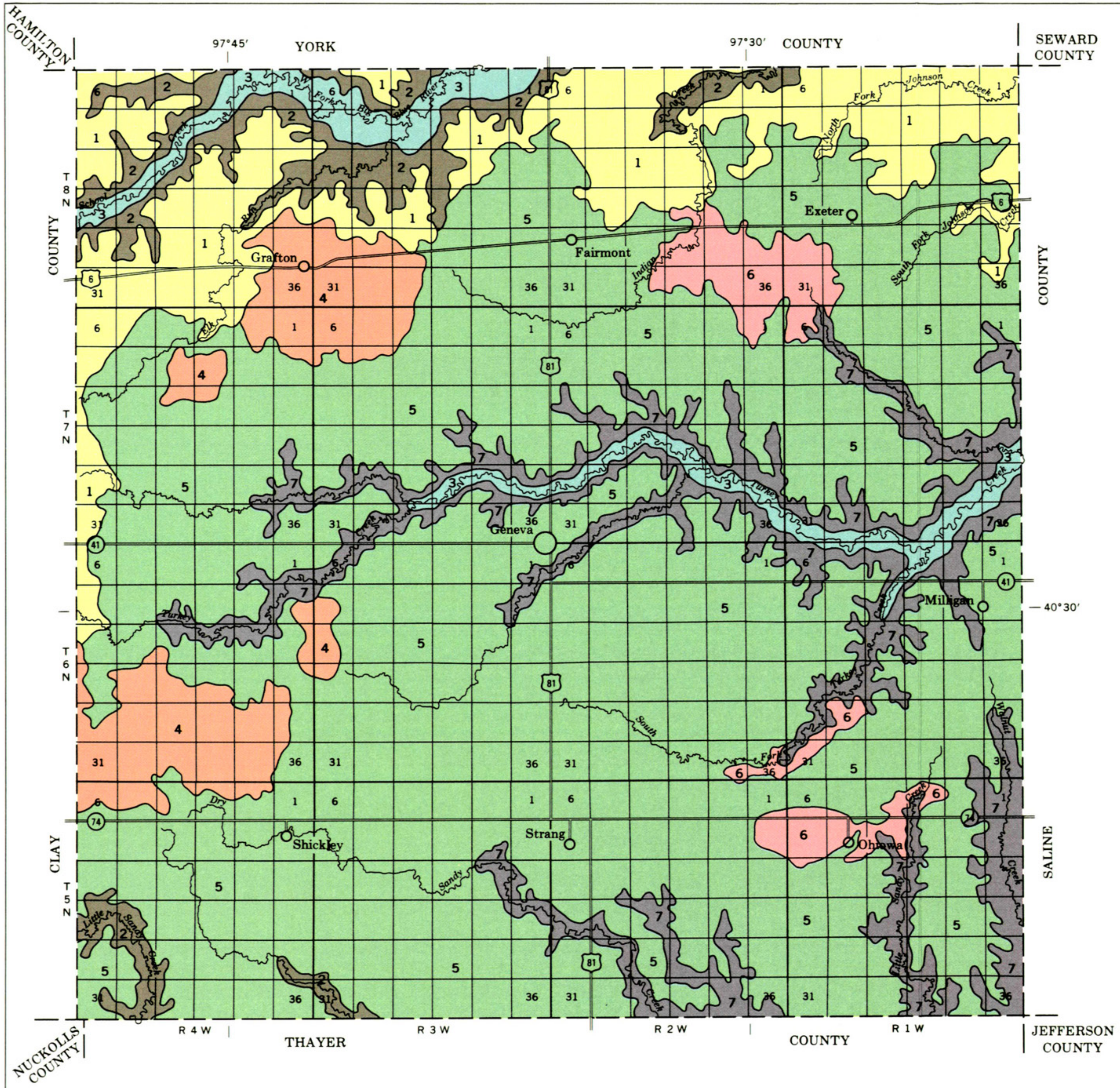
INTERPRETIVE GROUPS--Continued

Soil name and map symbol	Land capability* N	Land capability* I	Prime farmland*	Range site	Windbreak suitability group
HdC3 Hastings	IIIe	IIIe	---	Silty	3
HdD2 Hastings	IVe	IVe	---	Silty	3
He Hobbs	IIw	IIw	Yes	Silty Overflow	1
Hf Hobbs	VIw	---	---	Silty Overflow	10
HhD2 Holder	IVe	IVe	---	Silty	3
Ke Kezan	Vw	---	---	Subirrigated	10
Ma Massie	VIIIw	---	---	---	10
Mu Muir	I	I	Yes	Silty Lowland	1
MuB Muir	IIe	IIe	Yes	Silty Lowland	1
MuC Muir	IIIe	IIIe	Yes	Silty Lowland	1
Ob	IIIs	IIIs	---		
Olbut				Saline Lowland	9S
Butler				Clayey	2W
Pt Pits	VIIIs	---	---	---	10
Sc Scott	IVw	---	---	---	10
Sd Scott	IIIw	IIIw	---	Clayey Overflow	2W
UyE2 Uly	VIe	---	---	Silty	3
UyF	VIe	---	---		
Uly				Silty	10
Hobbs				Silty Overflow	1

* A soil complex is treated as a single management unit in the land capability and prime farmland columns. The N column is for nonirrigated soils; the I column is for irrigated soils.
** Where drained.

☆U.S. GOVERNMENT PRINTING OFFICE : 1986 O - 478-164 : QL 3

NRCS Accessibility Statement



SOIL LEGEND*

1 HASTINGS-CRETE association: Deep, nearly level to gently sloping, well drained and moderately well drained, silty soils on uplands

2 HASTINGS-ULY-GEARY association: Deep, gently sloping to steep, well drained and somewhat excessively drained, silty soils on uplands

3 MUIR-HOBBS-BUTLER association: Deep, nearly level to gently sloping, well drained and somewhat poorly drained, silty soils on stream terraces, foot slopes, and bottom lands

4 CRETE-HASTINGS-MASSIE association: Deep, nearly level to gently sloping, moderately well drained, well drained, and very poorly drained, silty soils on uplands and in upland depressions

5 CRETE-BUTLER association: Deep, nearly level to gently sloping, moderately well drained and somewhat poorly drained, silty soils on uplands

6 OLBUT-BUTLER association: Deep, nearly level, somewhat poorly drained, silty soils that are dominantly saline; on uplands

7 HASTINGS-CRETE-GEARY association: Deep, gently sloping to steep, well drained, moderately well drained, and somewhat excessively drained, silty soils on uplands

*Texture terms in the descriptive headings refer to the surface layer of the major soils in the associations.

Compiled 1984

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
UNIVERSITY OF NEBRASKA
CONSERVATION AND SURVEY DIVISION

GENERAL SOIL MAP
FILLMORE COUNTY, NEBRASKA

Scale 1:190,080

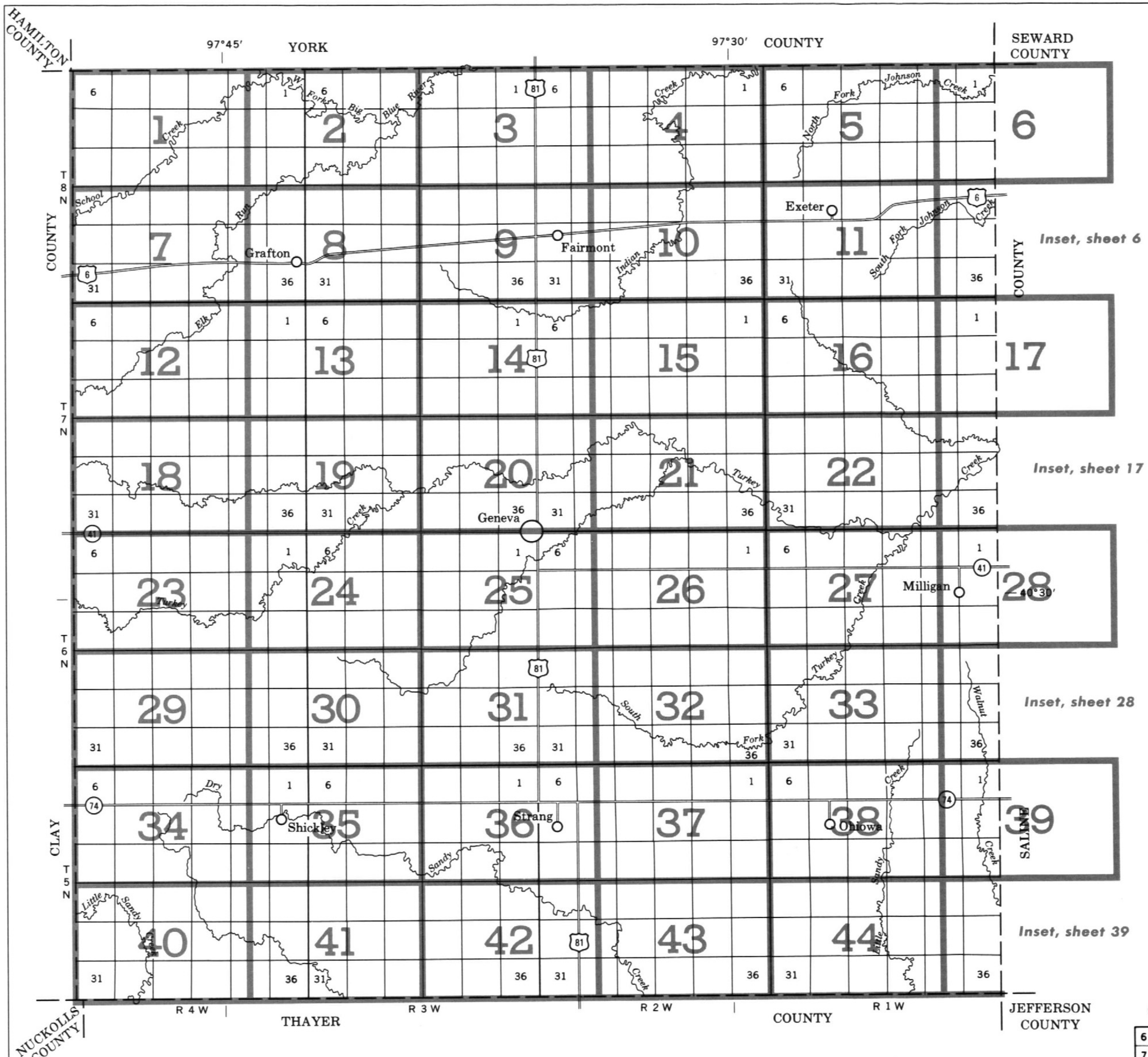
1 0 1 2 3 Miles

1 0 3 6 Km

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



INDEX TO MAP SHEETS
FILLMORE COUNTY, NEBRASKA

Scale 1:190,080

1 0 1 2 3 Miles

1 0 3 6 Km

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

SOIL LEGEND

Map symbols consist of a combination of letters or of letters and a number. The first capital letter is the initial one of the map unit name. The lowercase letter that follows separates map units having names that begin with the same letter, except that it does not separate sloping or eroded phases. The second capital letter indicates the class of slope. Symbols without a slope letter are for nearly level soils or miscellaneous areas. A final number of 2 indicates that the soil is eroded and 3 that it is severely eroded.

SYMBOL	NAME
Bu	Butler silt loam, 0 to 1 percent slopes
By	Butler silty clay loam, 0 to 1 percent slopes
Ce	Crete silt loam, 0 to 1 percent slopes
CeB	Crete silt loam, 1 to 3 percent slopes
CeC	Crete silt loam, 3 to 6 percent slopes
Cr	Crete silty clay loam, 0 to 1 percent slopes
CrB	Crete silty clay loam, 1 to 3 percent slopes
CrC2	Crete silty clay loam, 3 to 6 percent slopes, eroded
Ct	Crete silt loam, thick solum, 0 to 1 percent slopes
Fm	Fillmore silt loam, 0 to 1 percent slopes
Fo	Fillmore silt loam, drained, 0 to 1 percent slopes
GeC2	Geary silty clay loam, 3 to 6 percent slopes, eroded
GeD2	Geary silty clay loam, 6 to 11 percent slopes, eroded
GeE2	Geary silty clay loam, 11 to 17 percent slopes, eroded
GhF	Geary-Hobbs silt loams, 0 to 30 percent slopes
Hc	Hastings silt loam, 0 to 1 percent slopes
HcB	Hastings silt loam, 1 to 3 percent slopes
HcC	Hastings silt loam, 3 to 6 percent slopes
HcD	Hastings silt loam, 6 to 11 percent slopes
HdC2	Hastings silty clay loam, 3 to 6 percent slopes, eroded
HdC3	Hastings silty clay loam, 3 to 6 percent slopes, severely eroded
HdD2	Hastings silty clay loam, 6 to 11 percent slopes, eroded
He	Hobbs silt loam, 0 to 2 percent slopes
Hf	Hobbs silt loam, channeled
HhD2	Holder silty clay loam, 6 to 11 percent slopes, eroded
Ke	Kezan silt loam, channeled
Ma	Massie silty clay loam, 0 to 1 percent slopes
Mu	Muir silt loam, 0 to 1 percent slopes
MuB	Muir silt loam, 1 to 3 percent slopes
MuC	Muir silt loam, 3 to 6 percent slopes
Ob	Olbut-Butler silt loams, 0 to 1 percent slopes
Pt	Pits, gravel
Sc	Scott silt loam, 0 to 1 percent slopes
Sd	Scott silty clay loam, drained, 0 to 1 percent slopes
UyE2	Uly silt loam, 11 to 17 percent slopes, eroded
UyF	Uly-Hobbs silt loams, 0 to 30 percent slopes

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- County or parish
- Reservation (national forest or park, state forest or park, and large airport)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool — Davis Airstrip; FLOOD POOL LINE

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Federal — 410
- State — 52
- County, farm or ranch — 378

RAILROAD

DAMS

- Medium or small — water; w

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Located object (label) — Tower

WATER FEATURES

DRAINAGE

- Perennial, single line
- Intermittent
- Drainage end

Canals or ditches

- Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial — water; w
- Intermittent — int; i

MISCELLANEOUS WATER FEATURES

- Marsh or swamp (up to 3 acres)
- Well, irrigation
- Wet spot (up to 3 acres)

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS — Ce; HcB

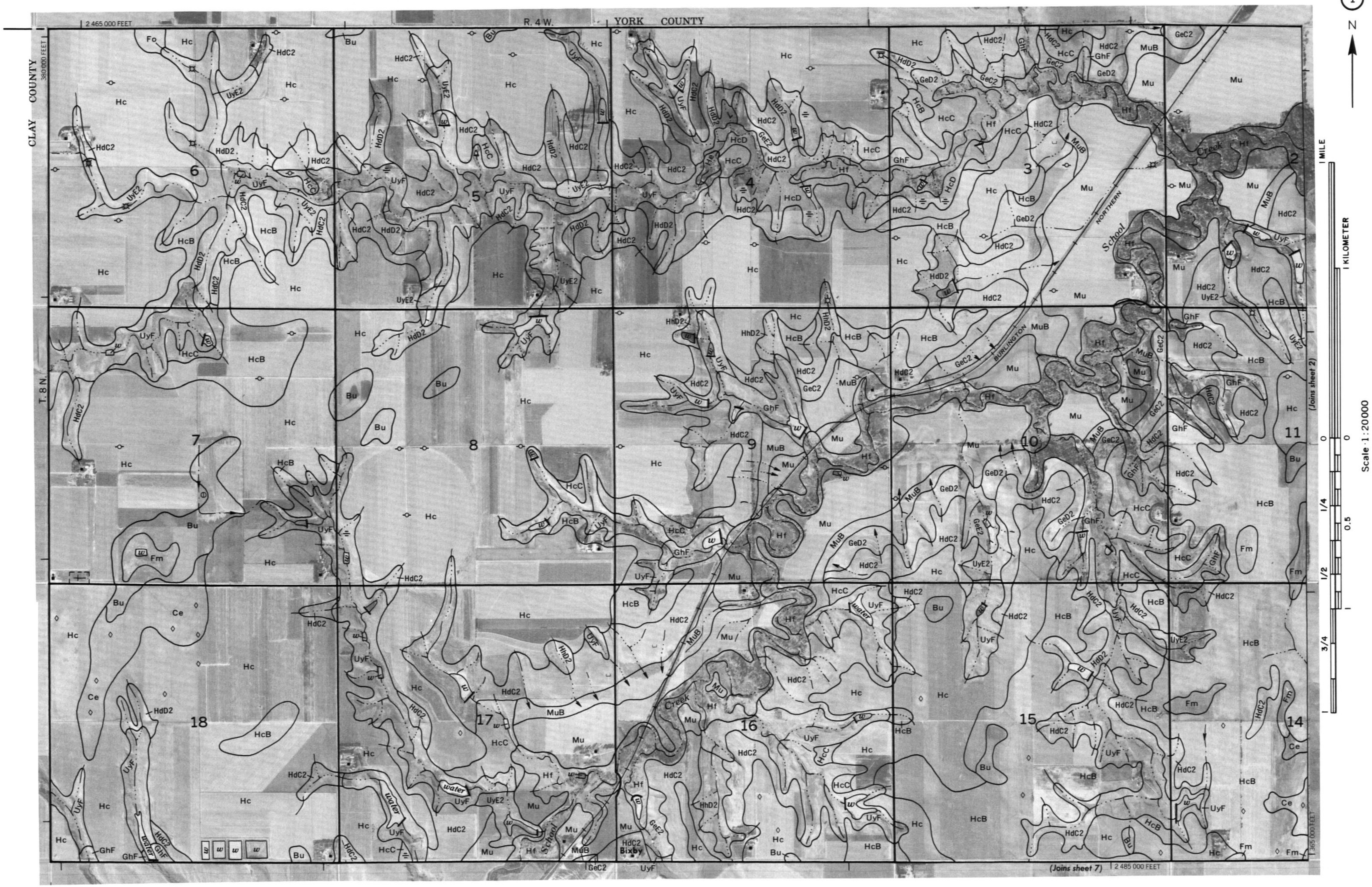
GULLY

DEPRESSION OR SINK (up to 2 acres)

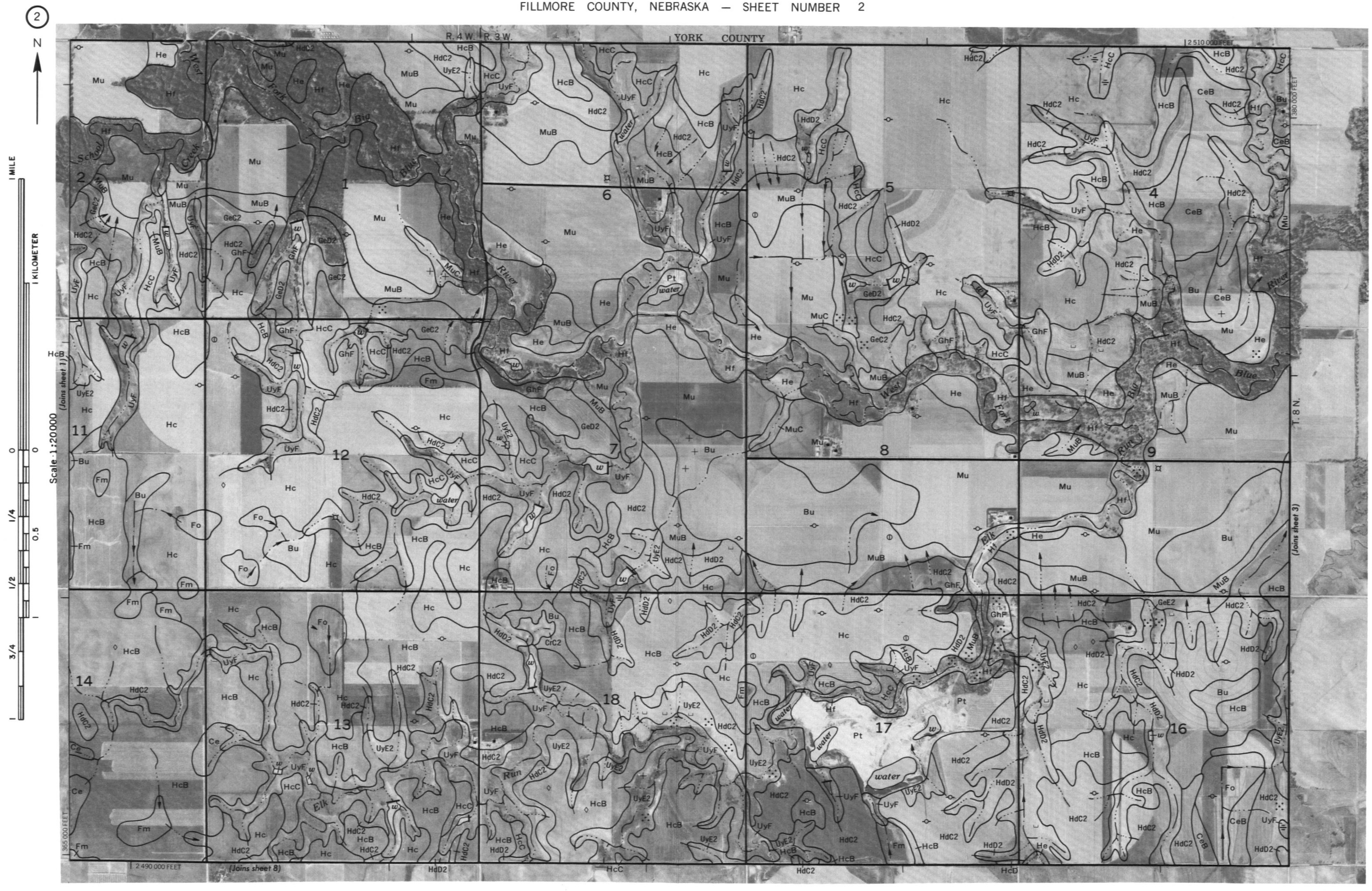
- Gravelly spot (up to 3 acres)
- Saline spot (up to 3 acres)
- Sandy spot (up to 3 acres)
- Severely eroded spot (up to 5 acres)
- Irrigation tailwater recovery pit
- Cut areas (up to 3 acres)
- Inlet to tile drains
- Sandpit (up to 2 acres)
- Reddish brown loess outcrop (up to 5 acres)

FILLMORE COUNTY, NEBRASKA — SHEET NUMBER 1

1



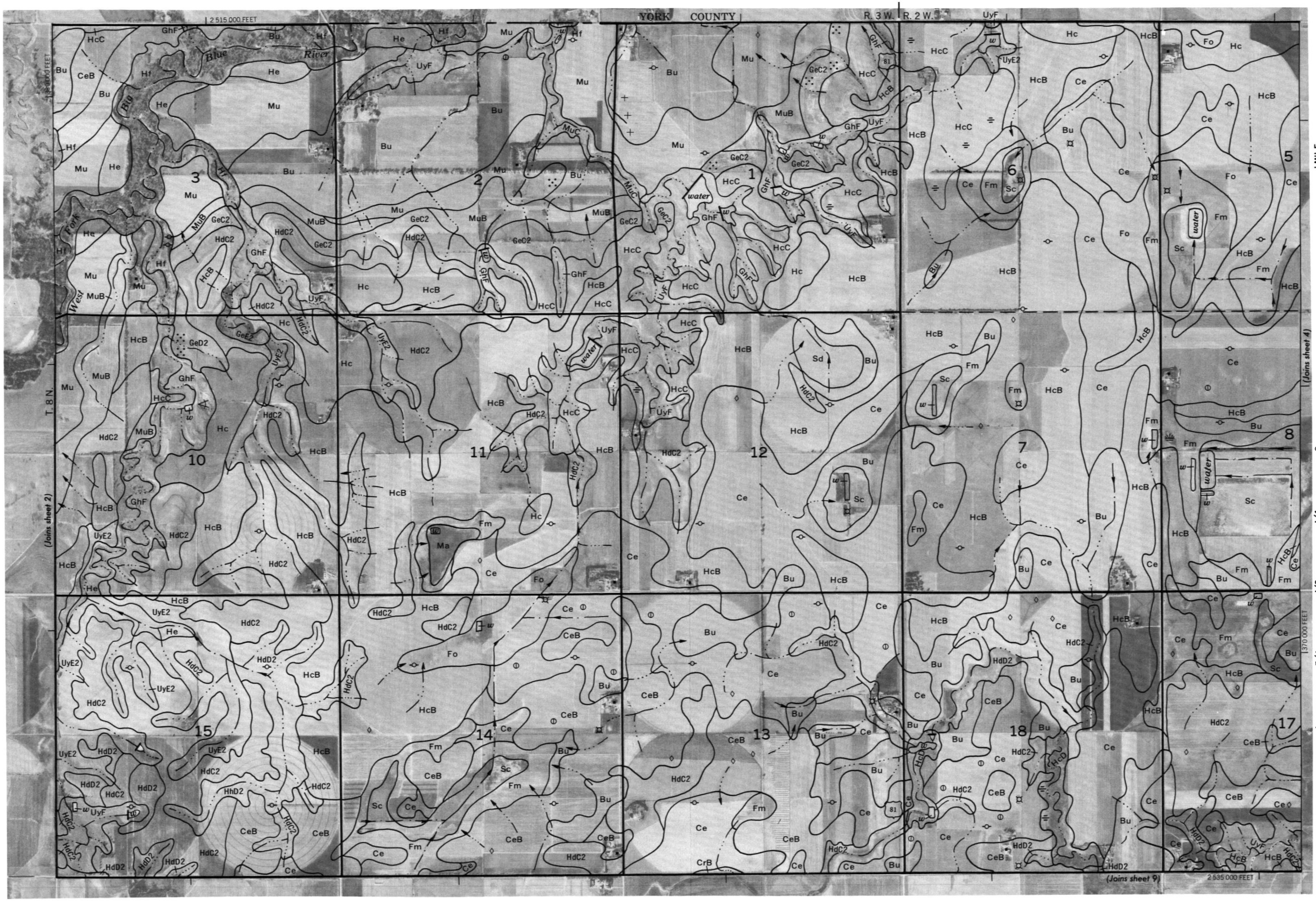
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

3

N



I MILE

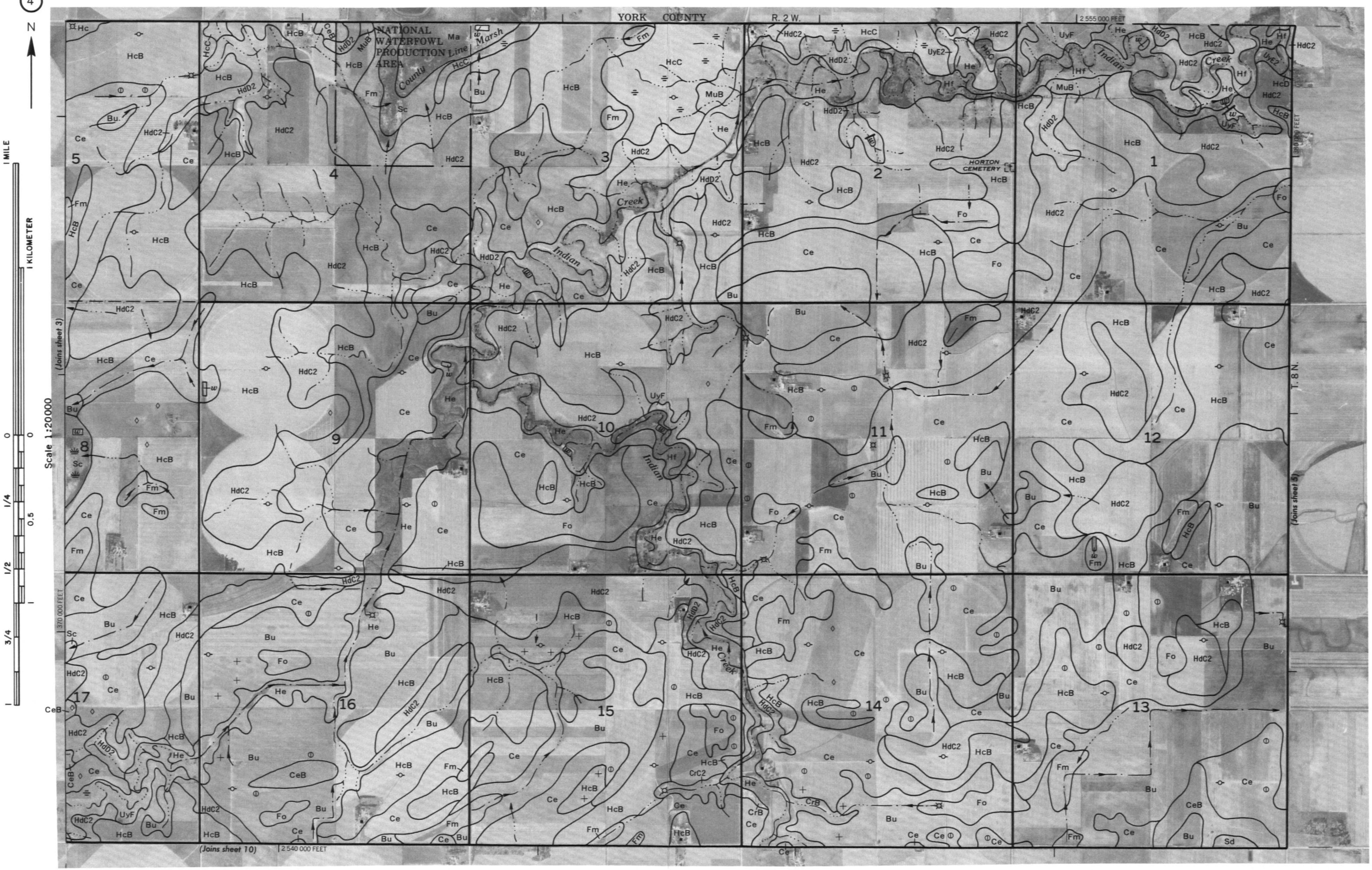
I KILOMETER

Scale 1:20000

0 1/4 1/2 3/4 1

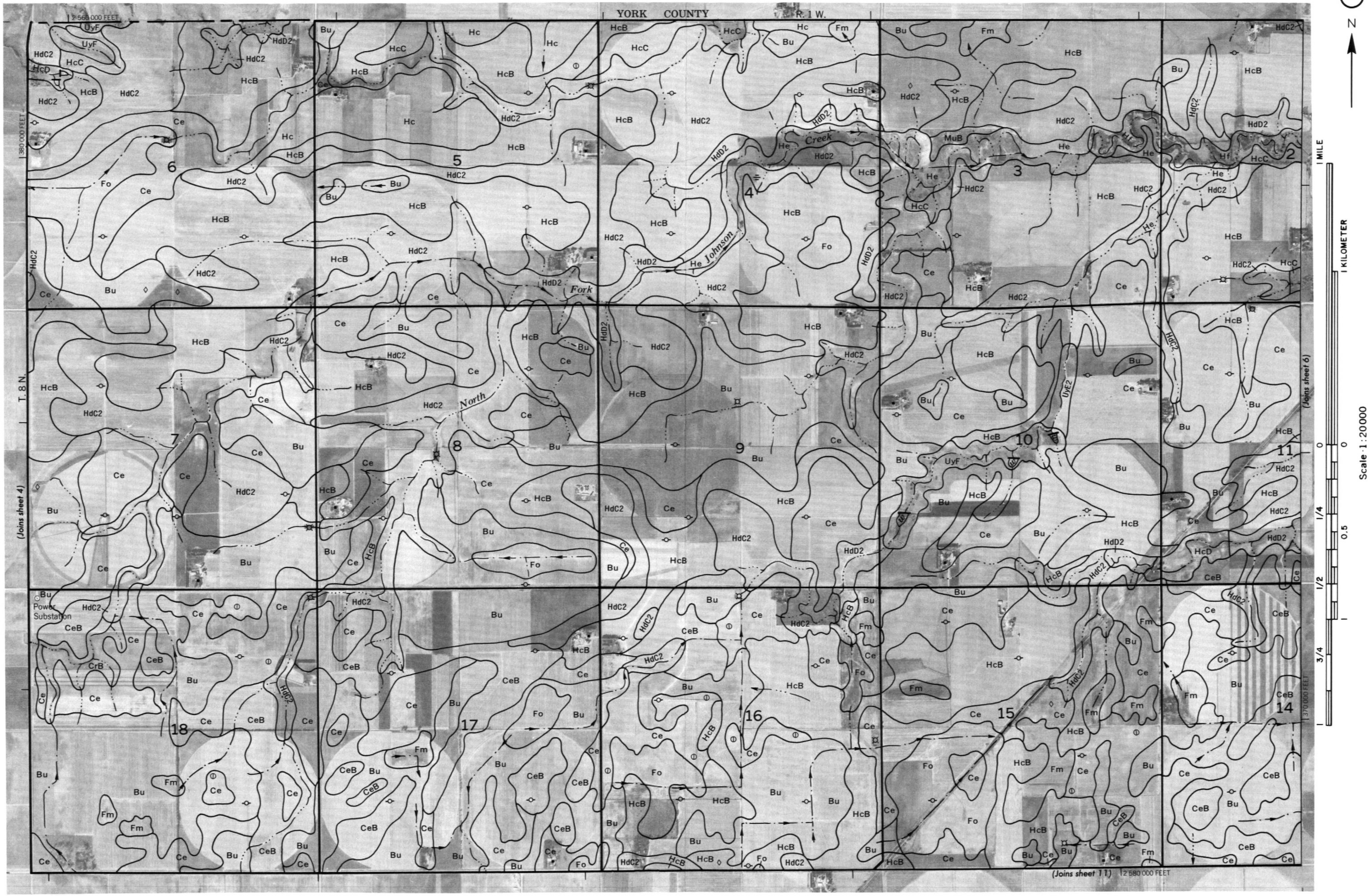
0 0.5 1

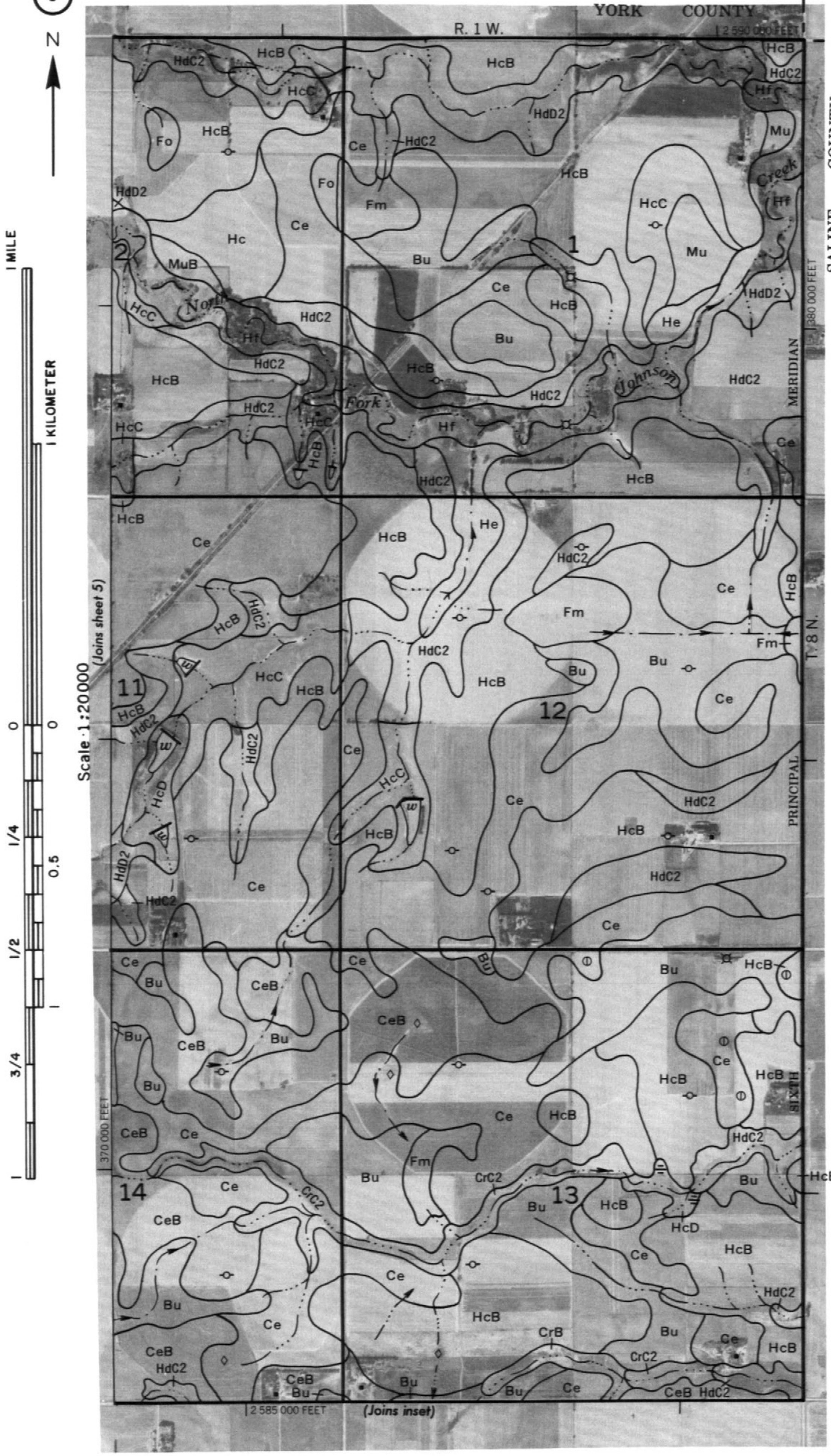
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

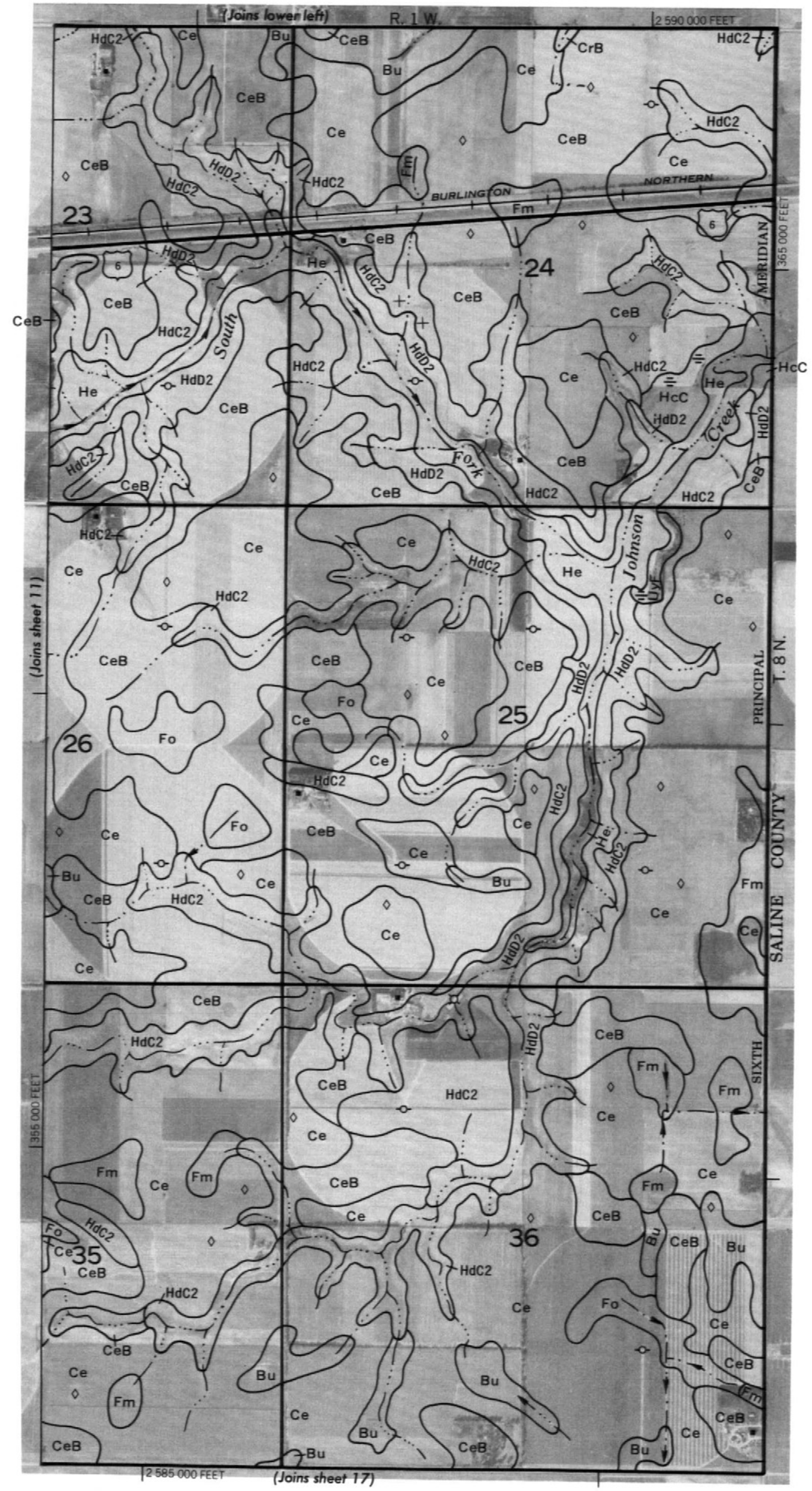


This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



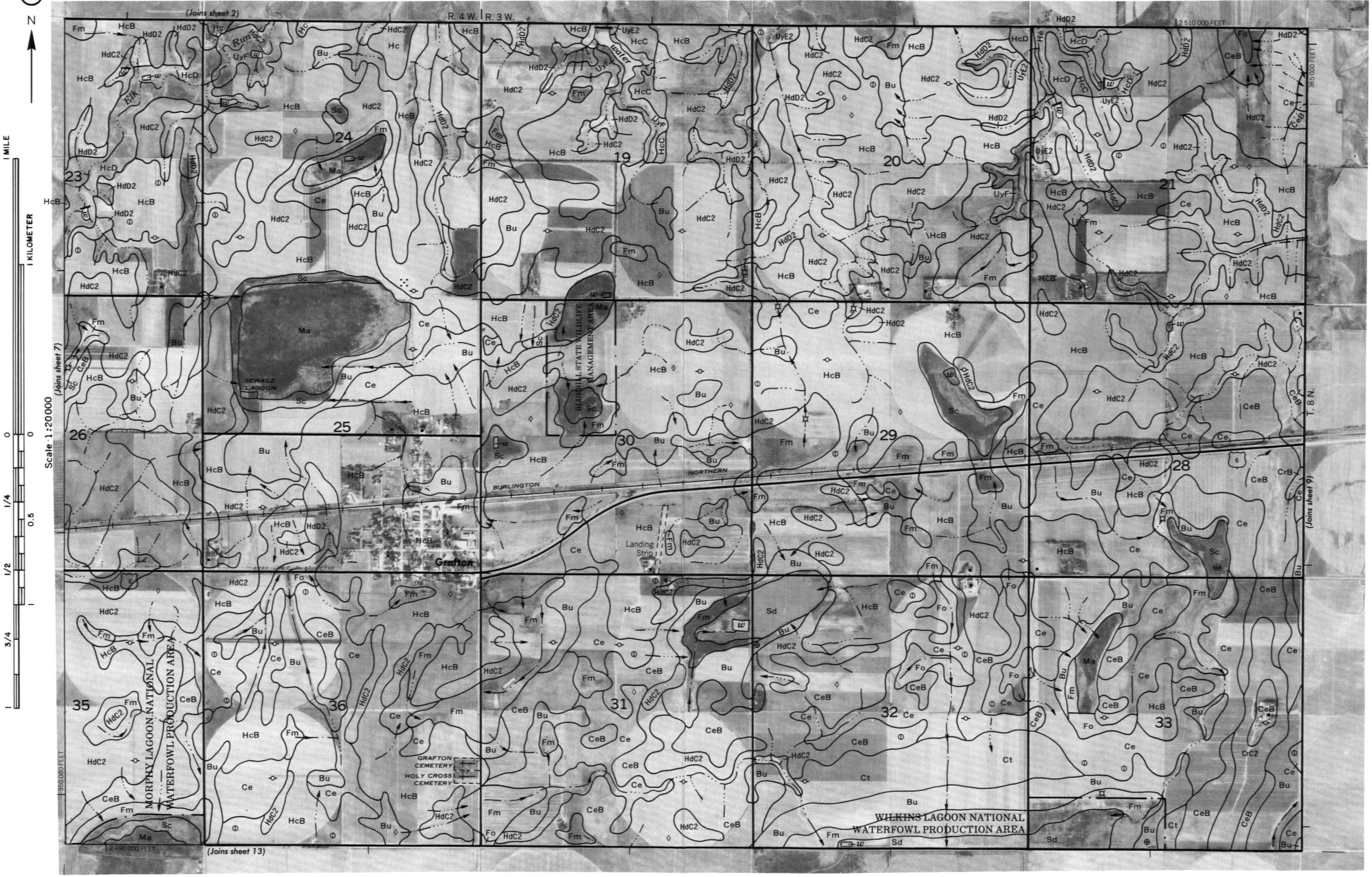




This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

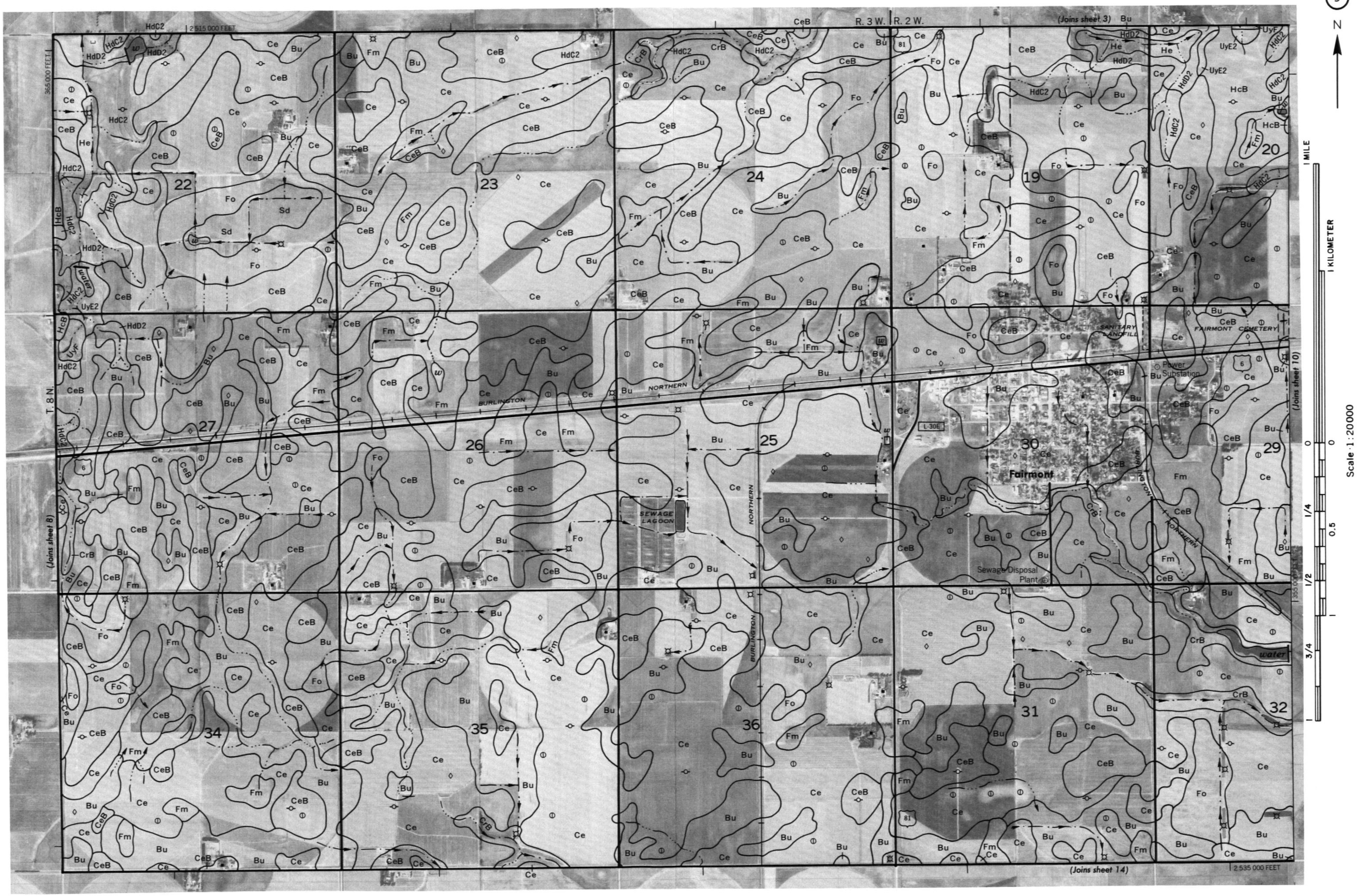
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

8

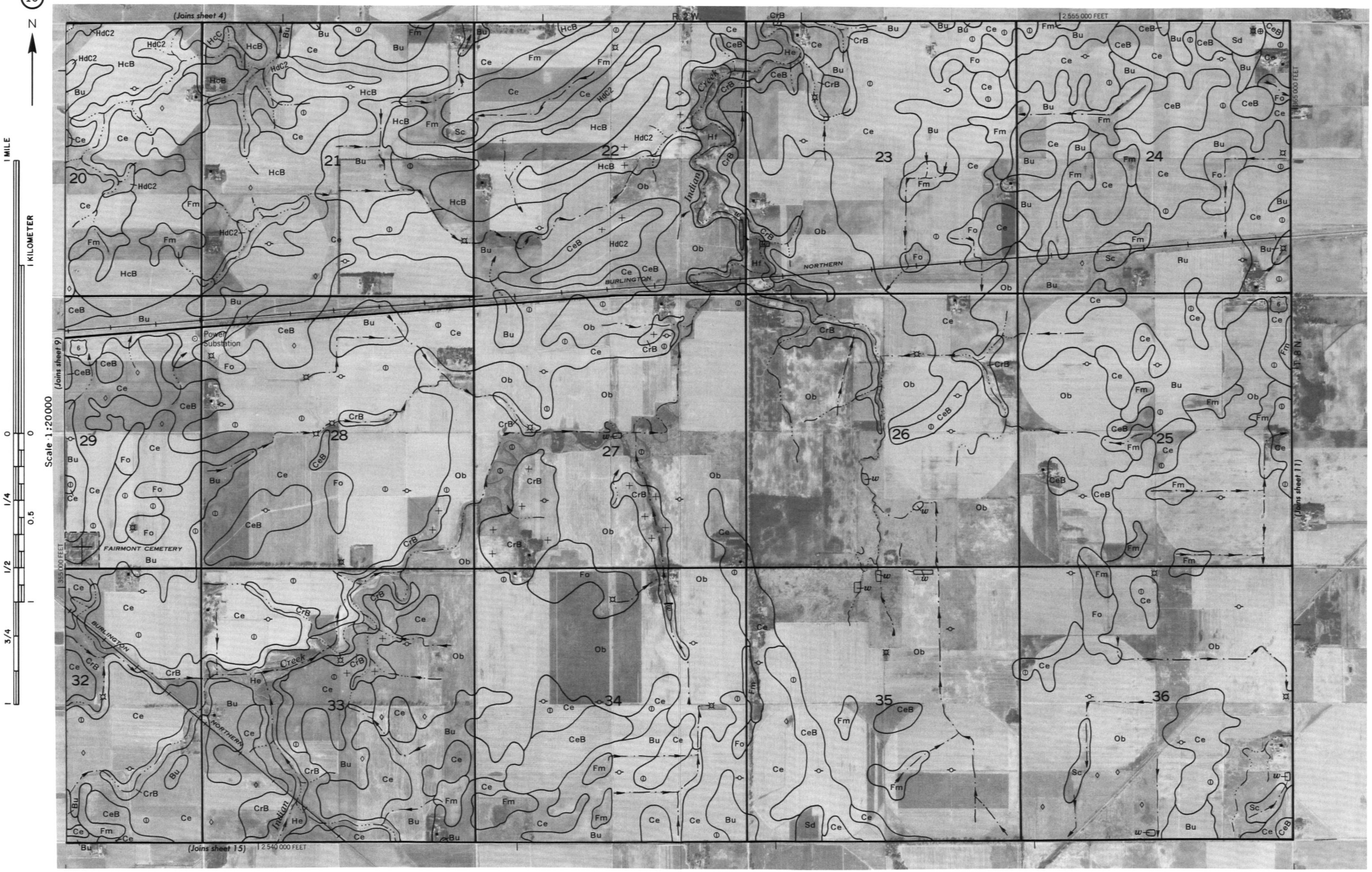


This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

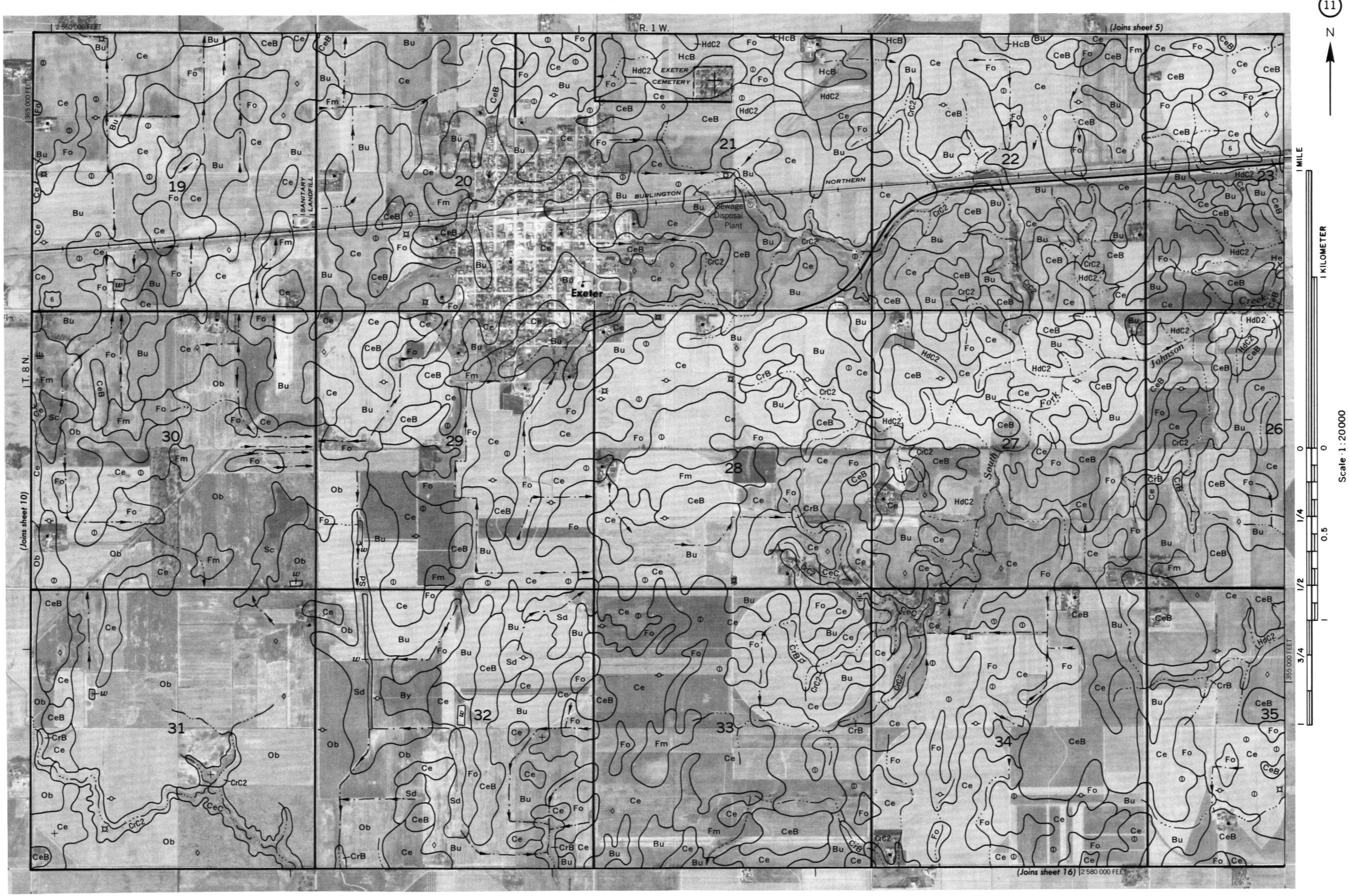
FILLMORE COUNTY, NEBRASKA — SHEET NUMBER 9



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

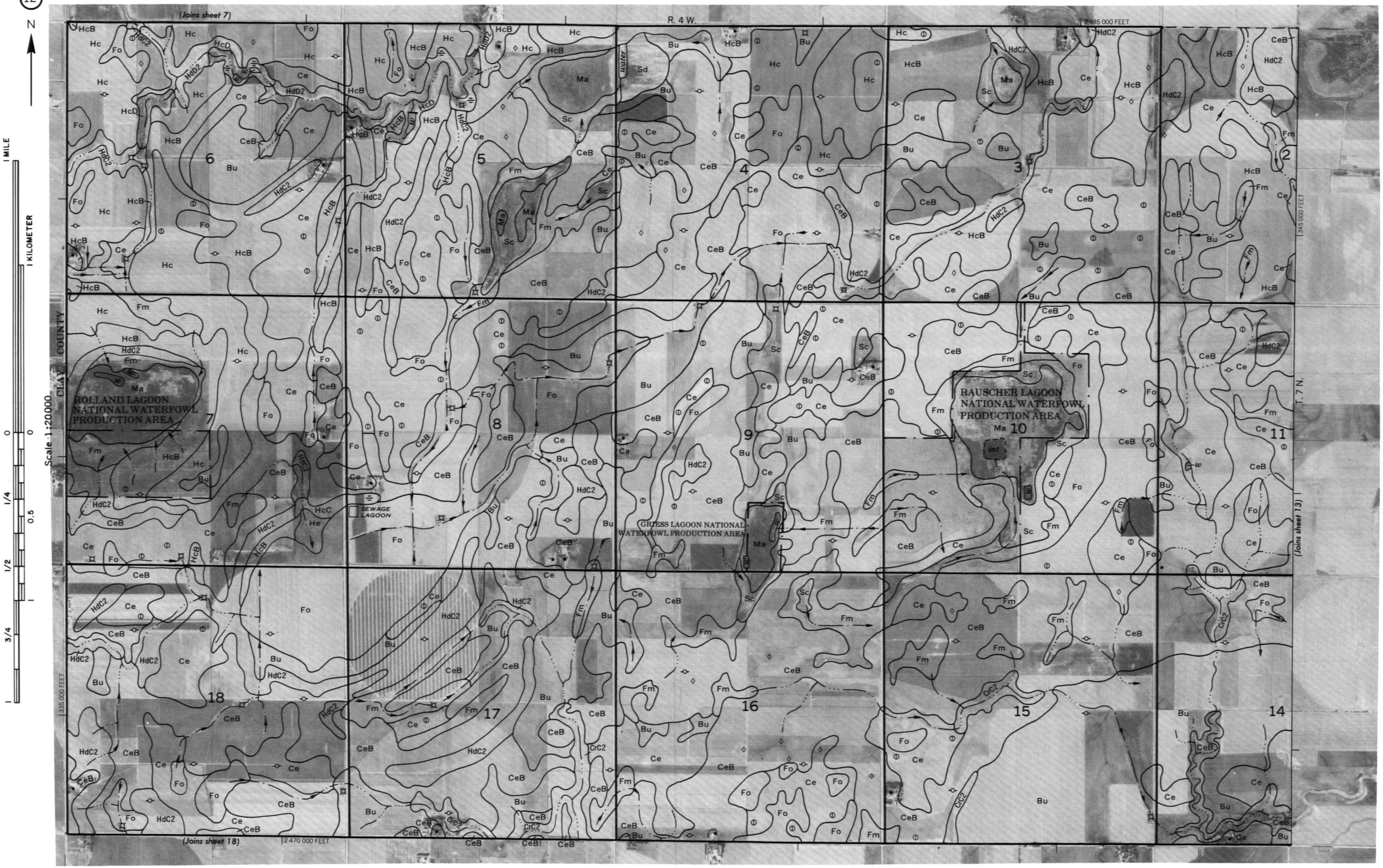


This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

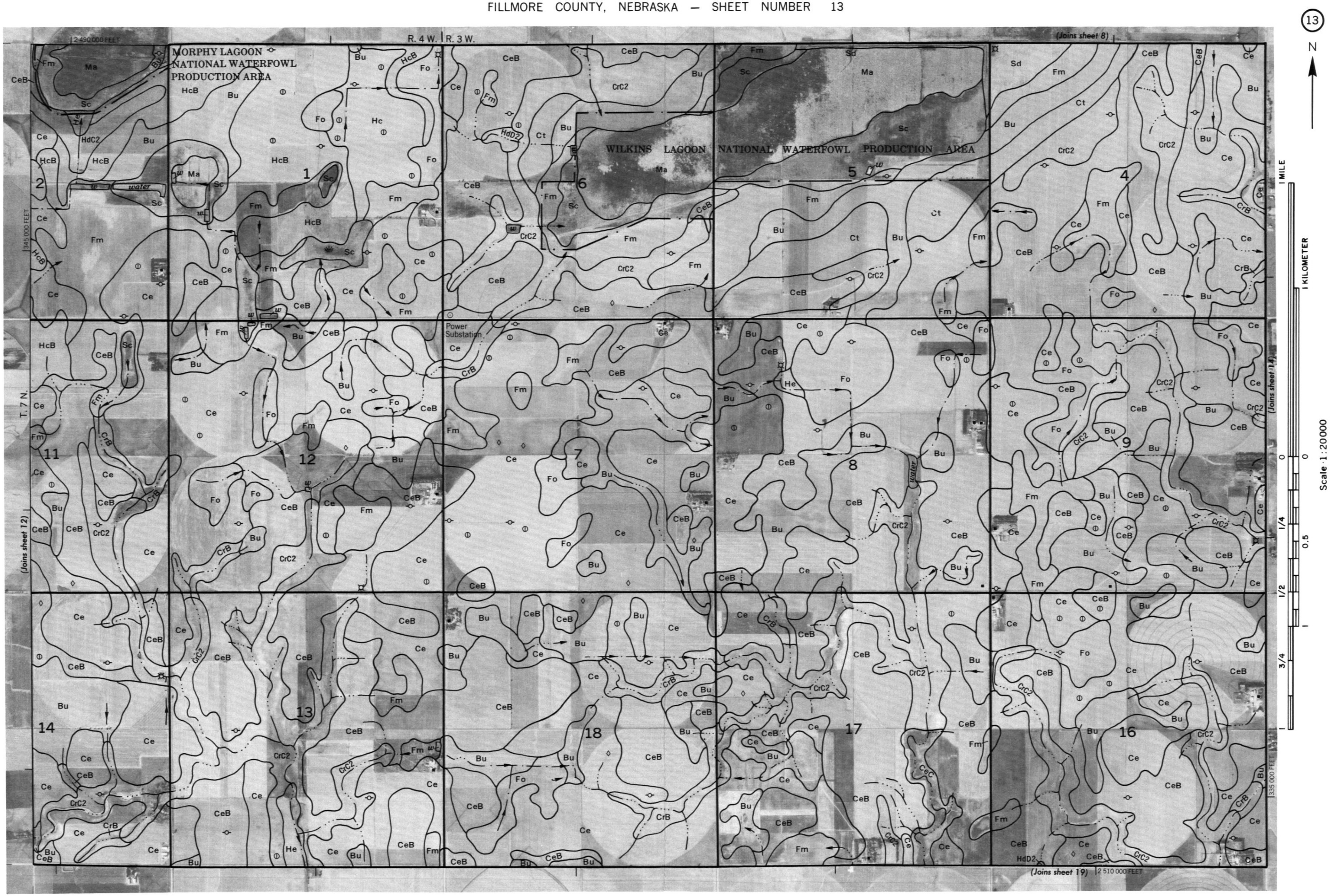


This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

12

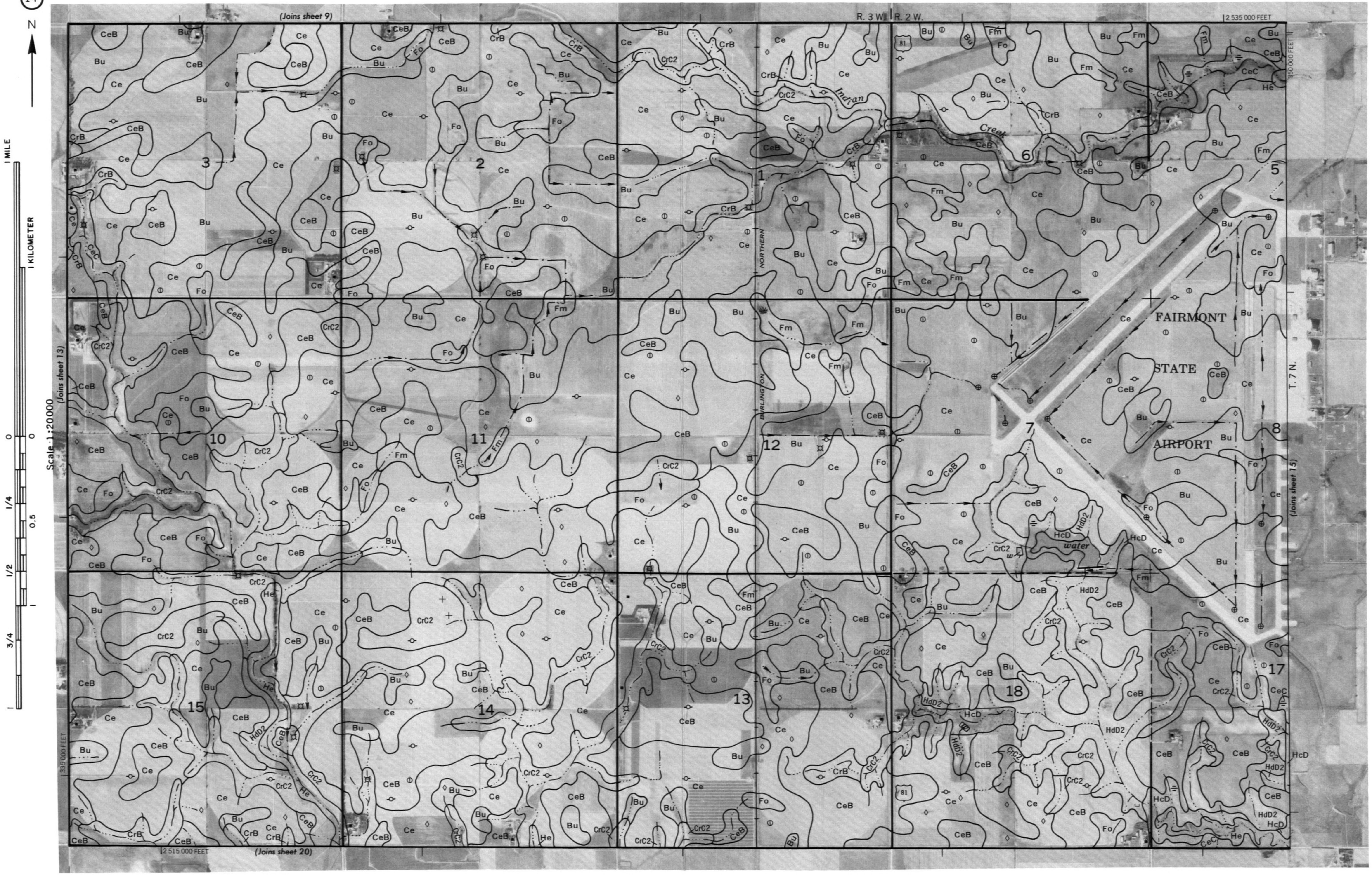


This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

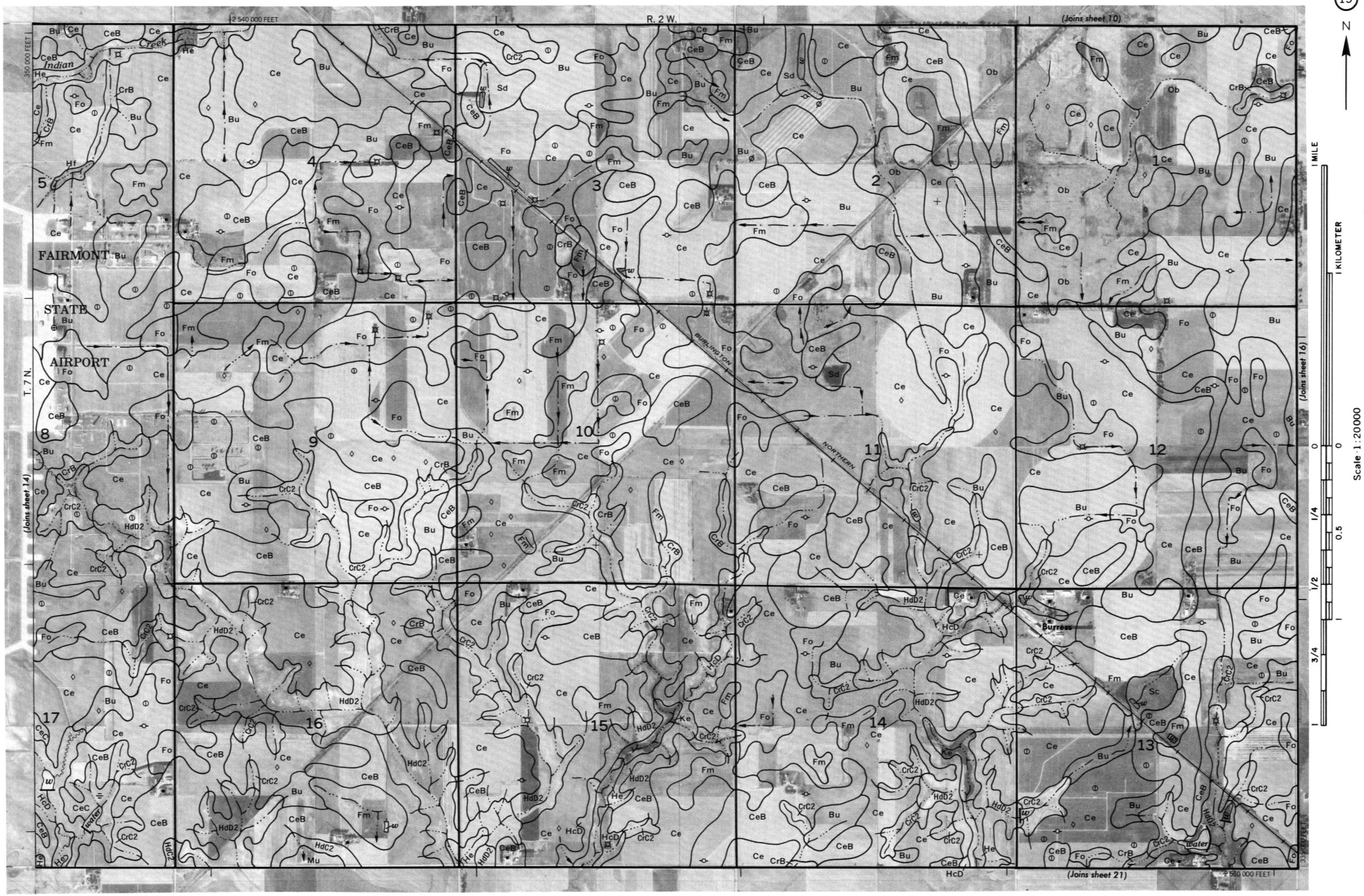


This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

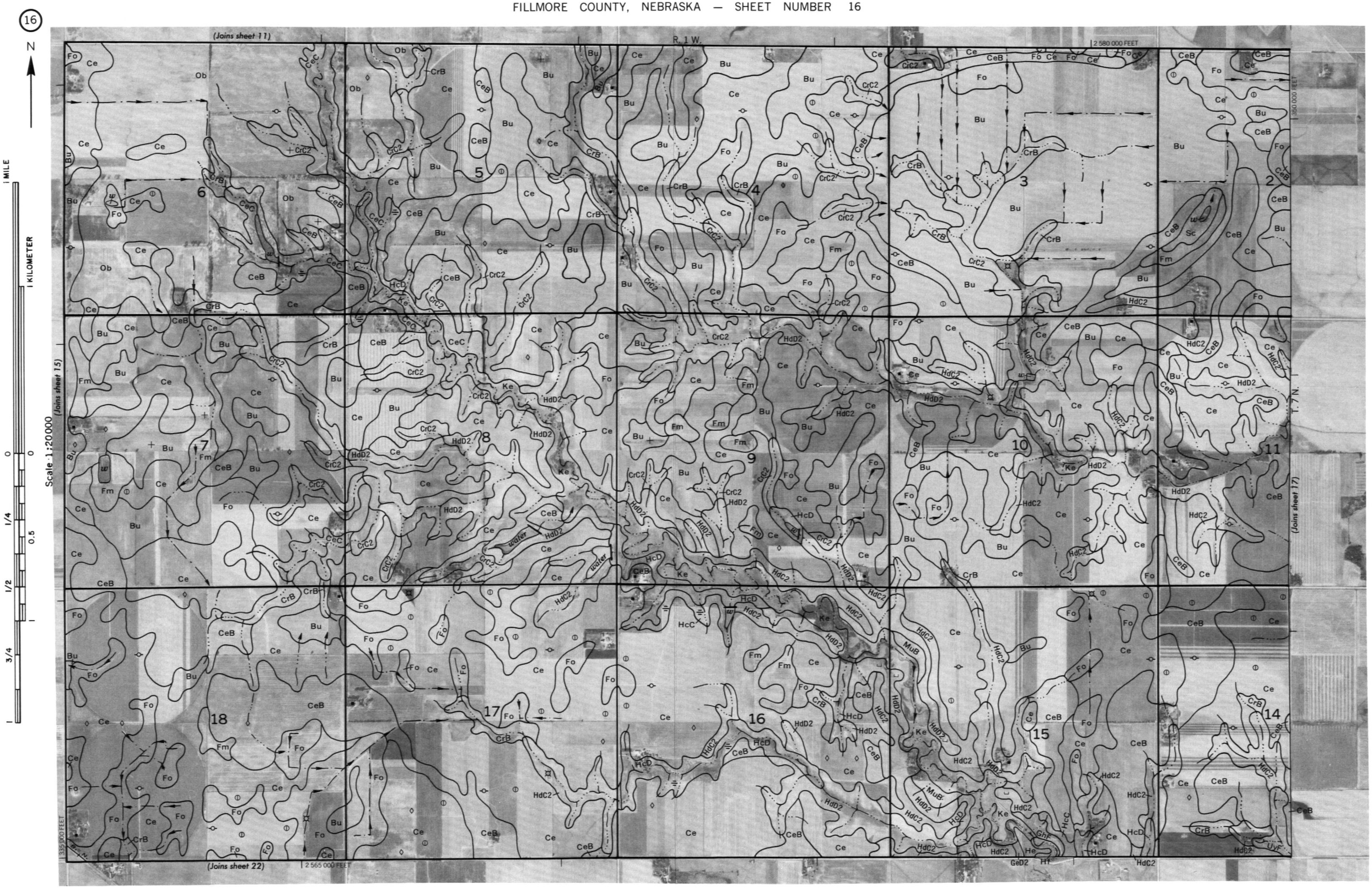
14



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

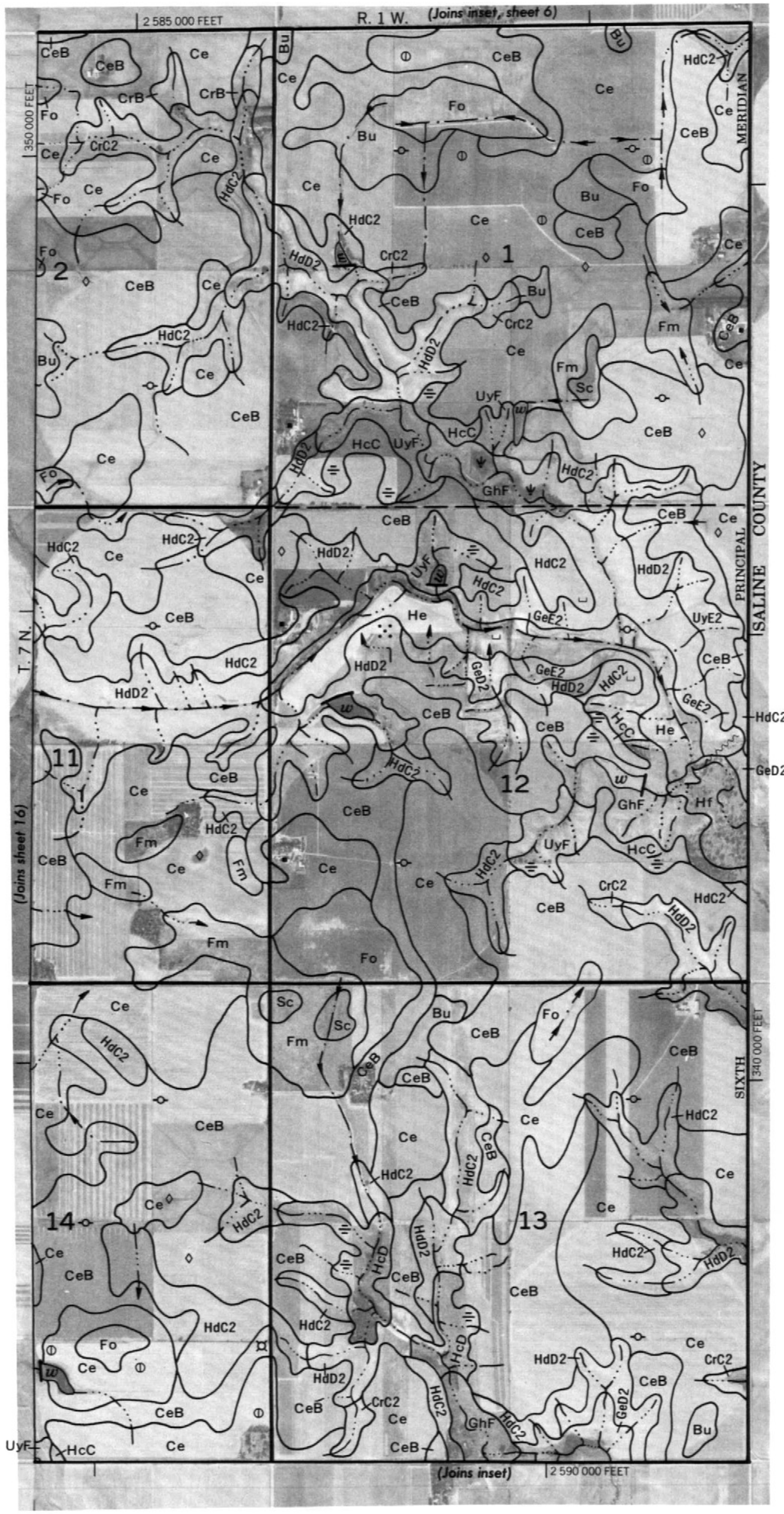


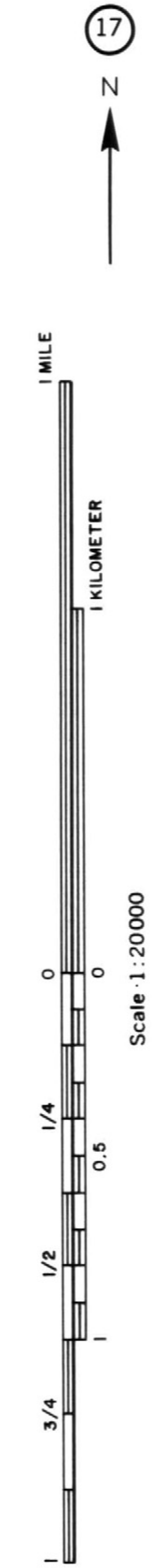
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

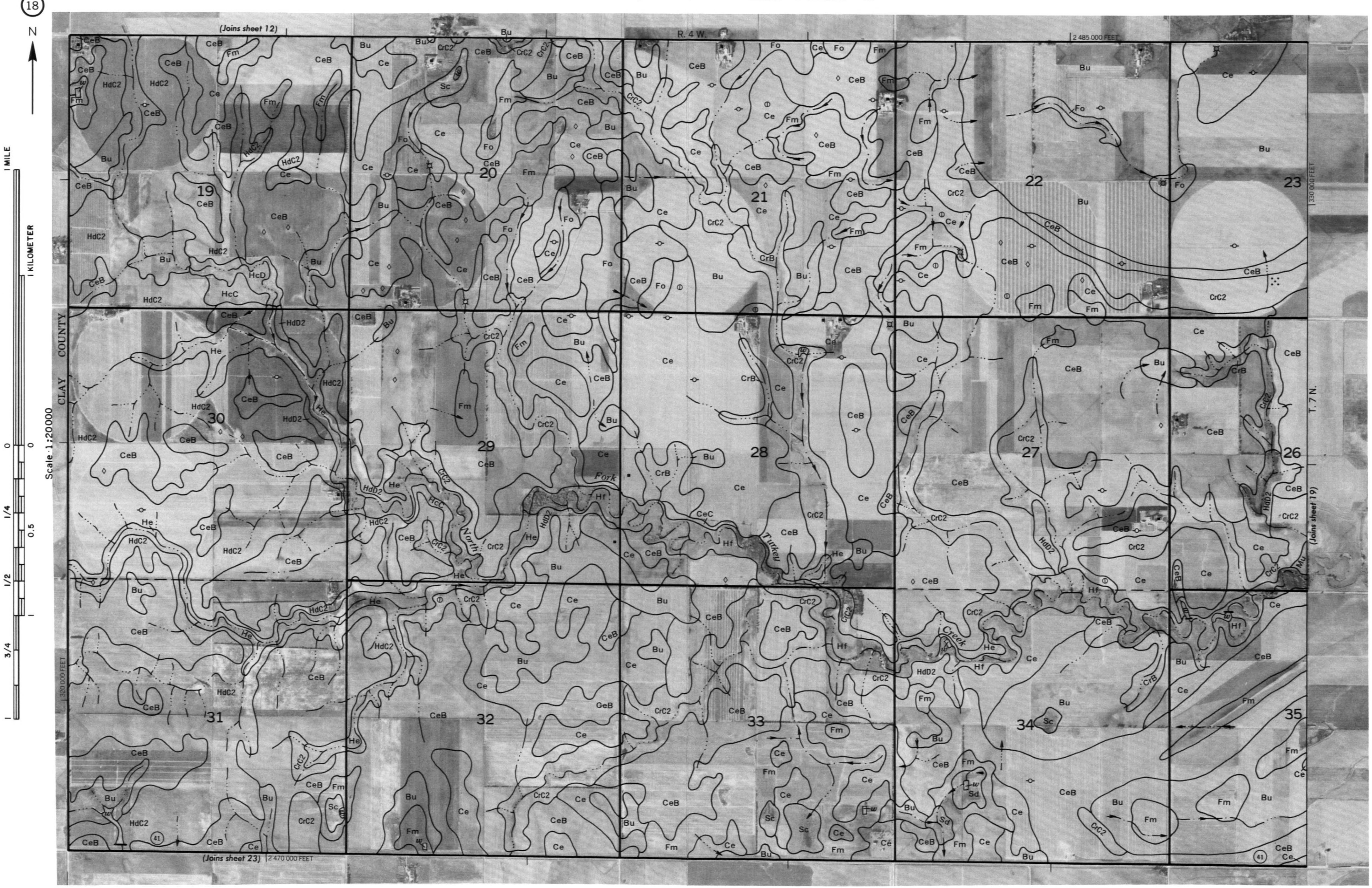


This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

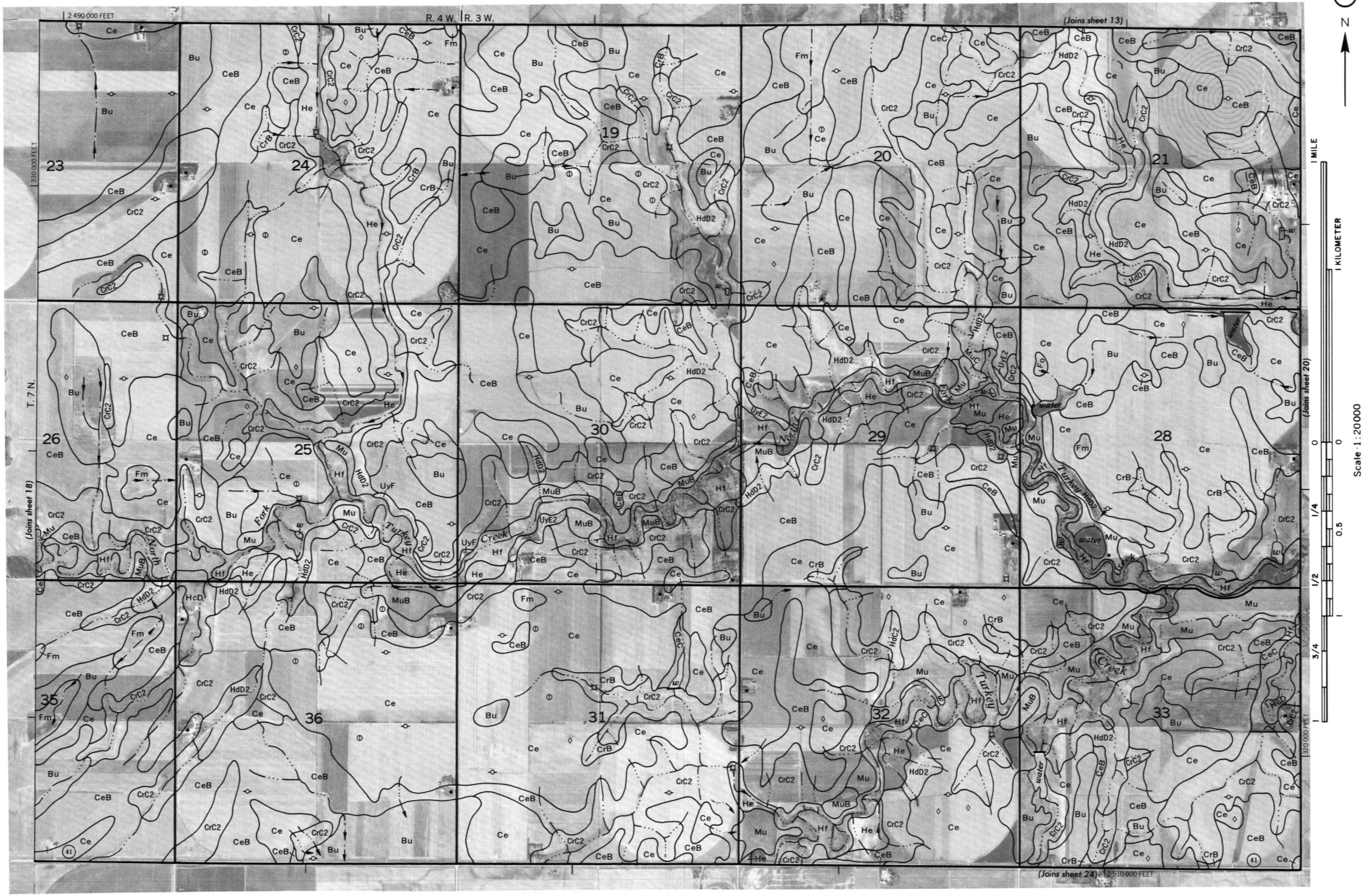
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



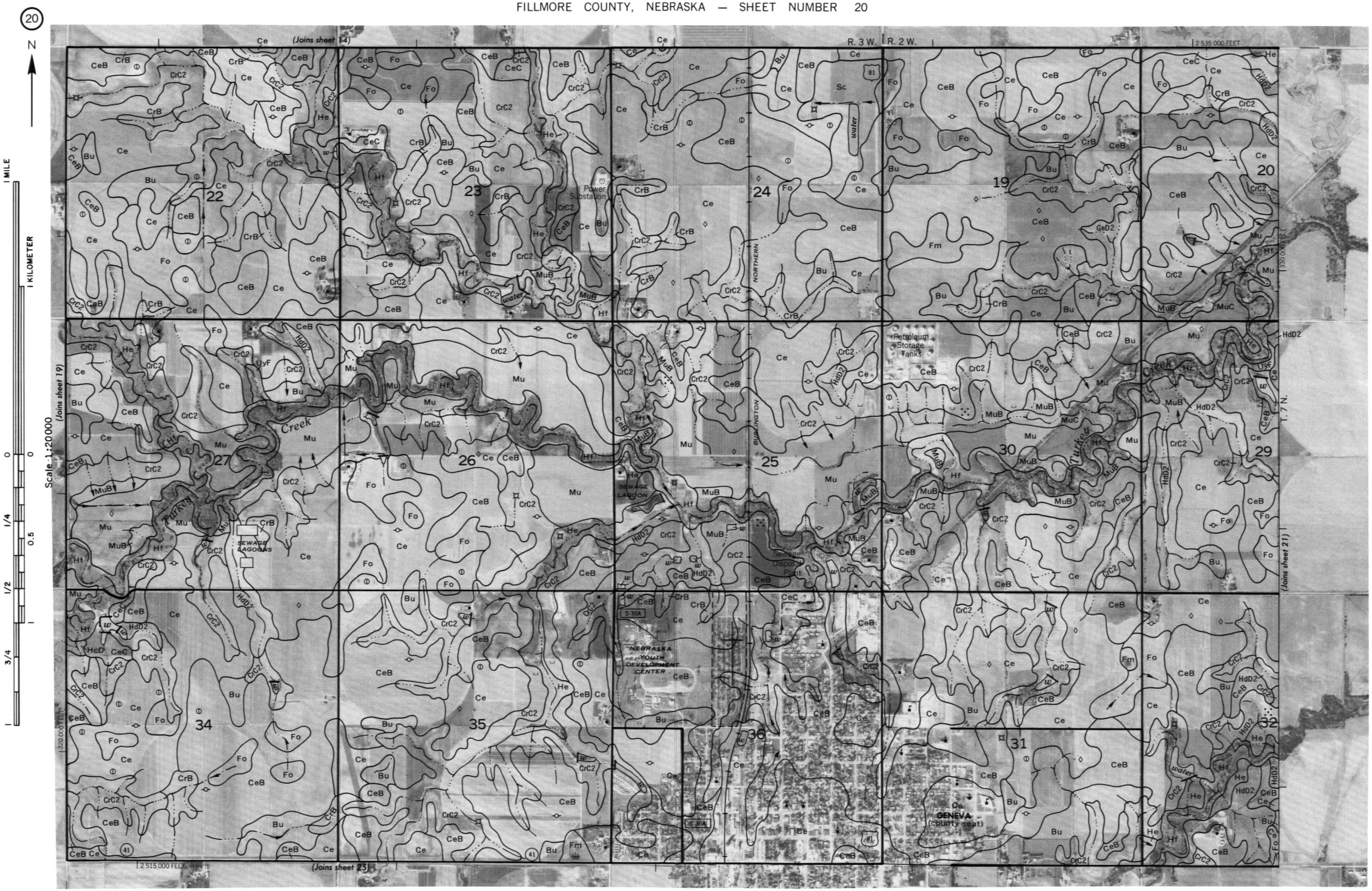




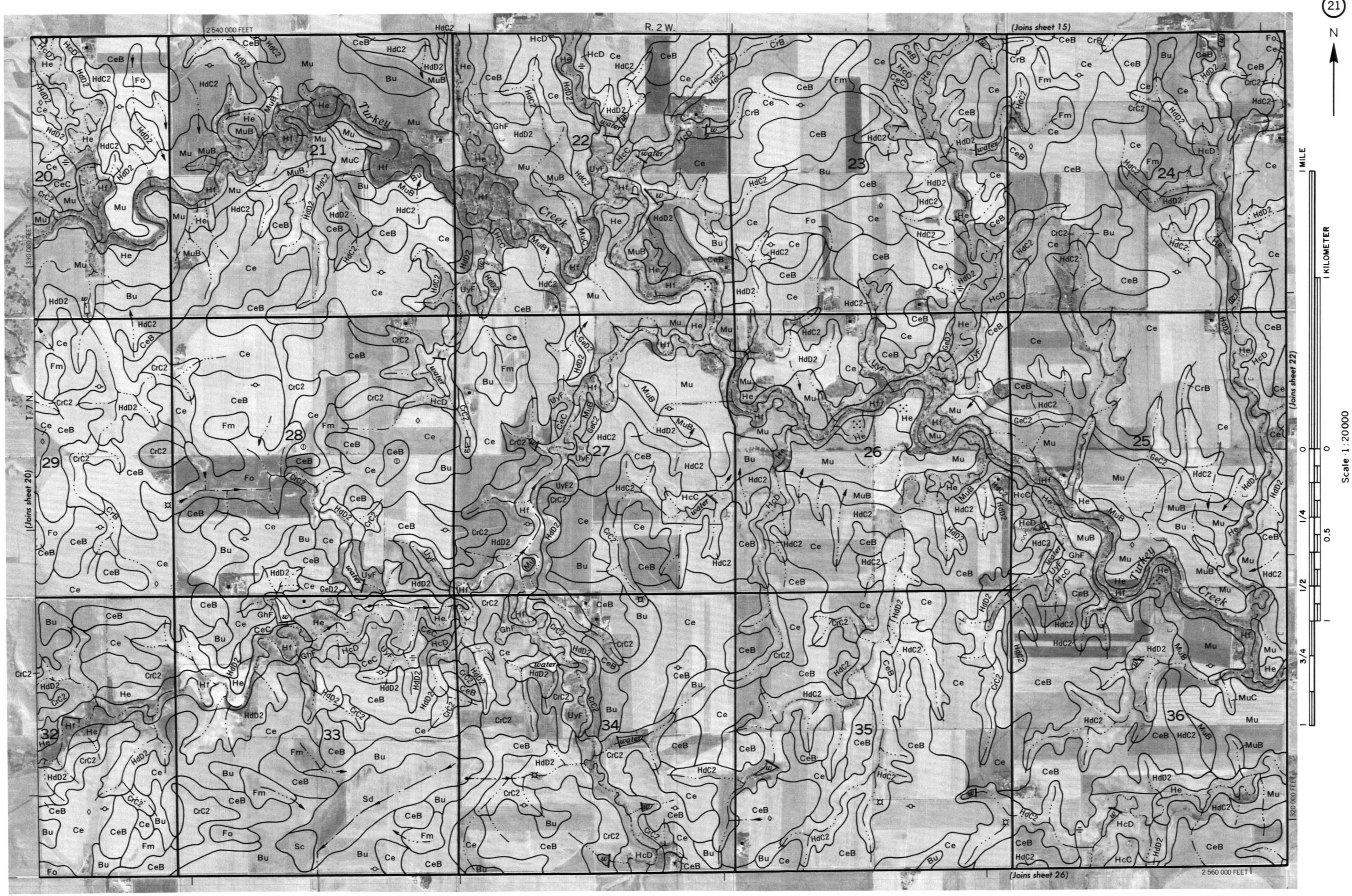
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



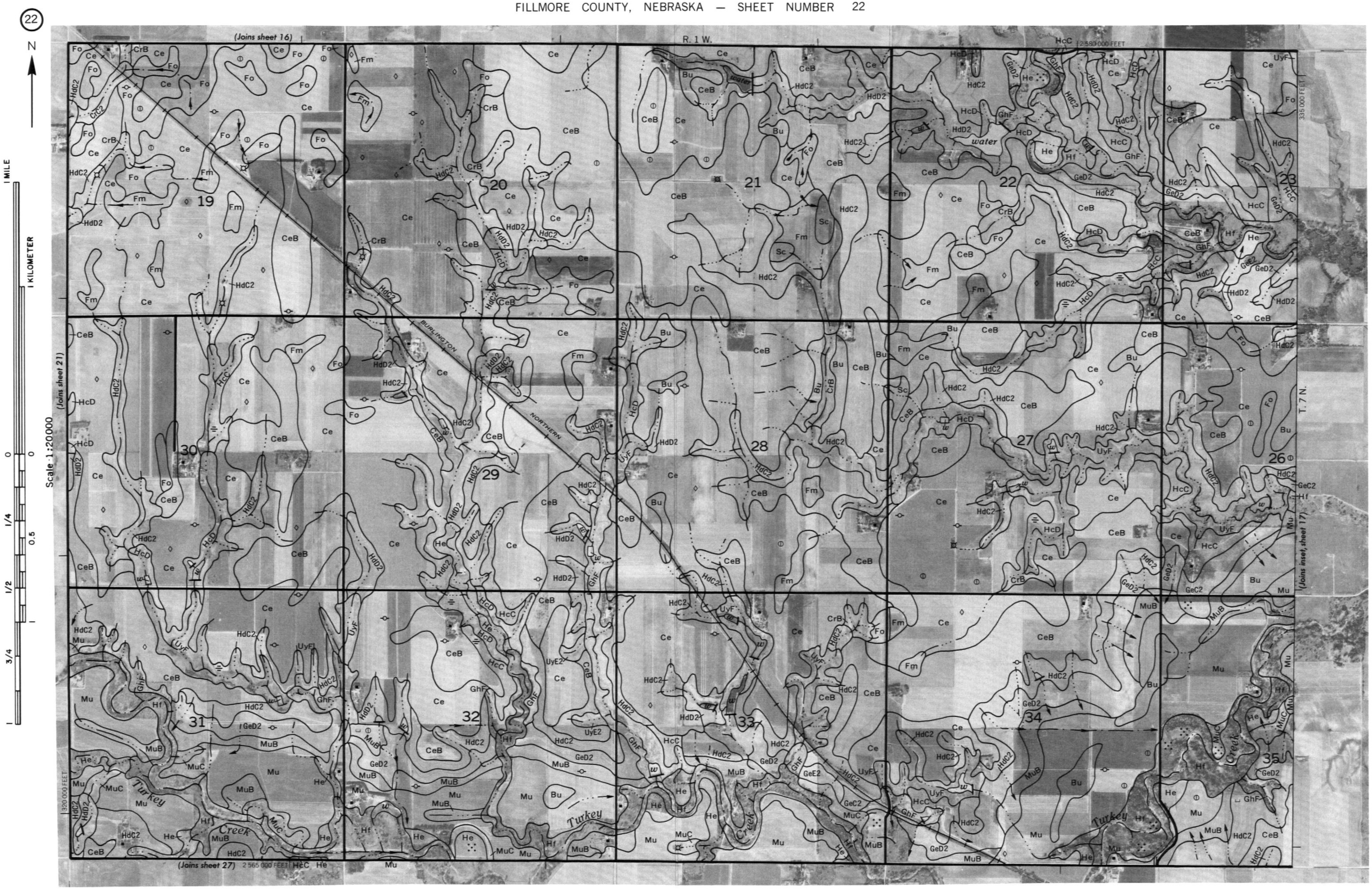
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



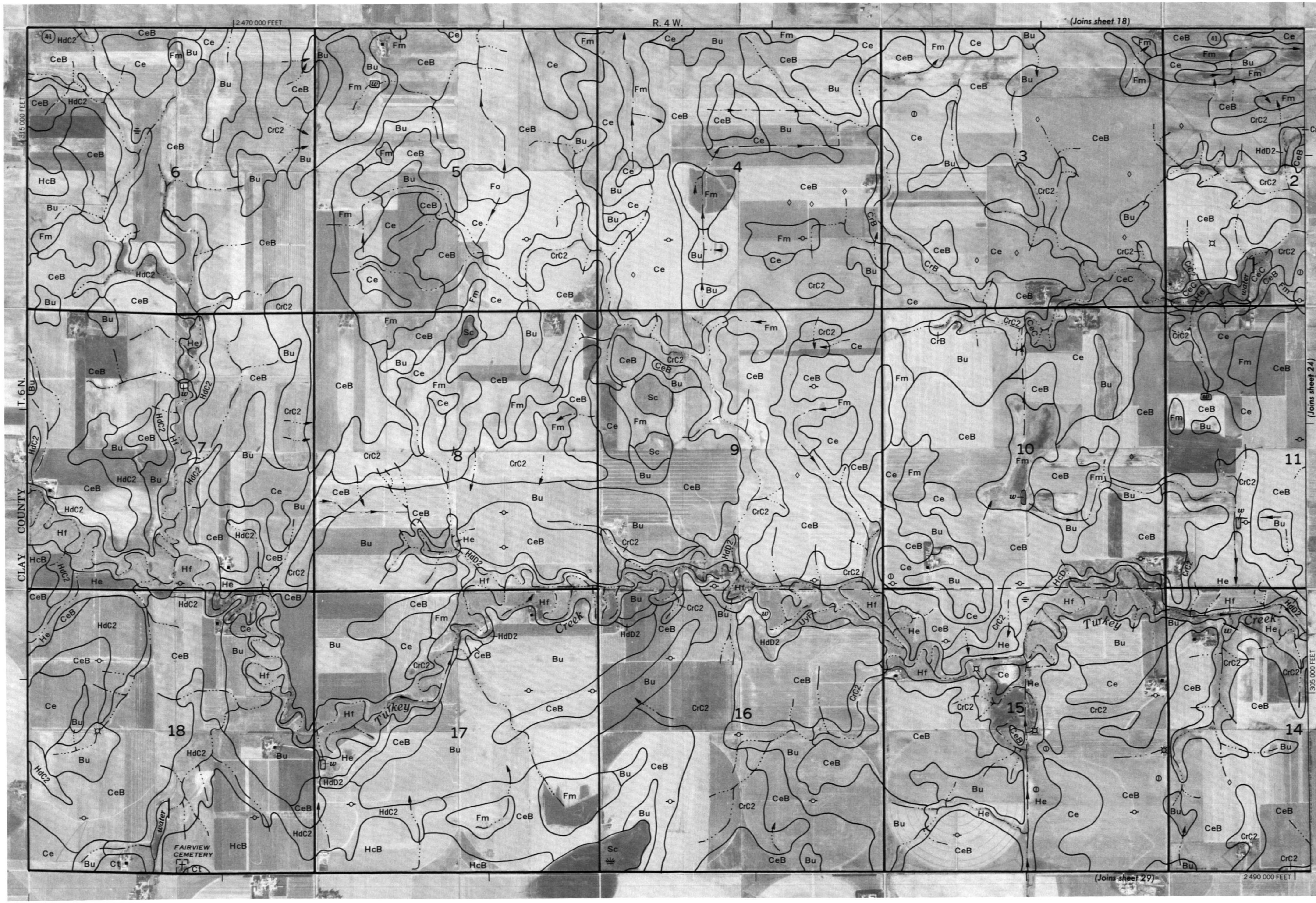
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

23

N

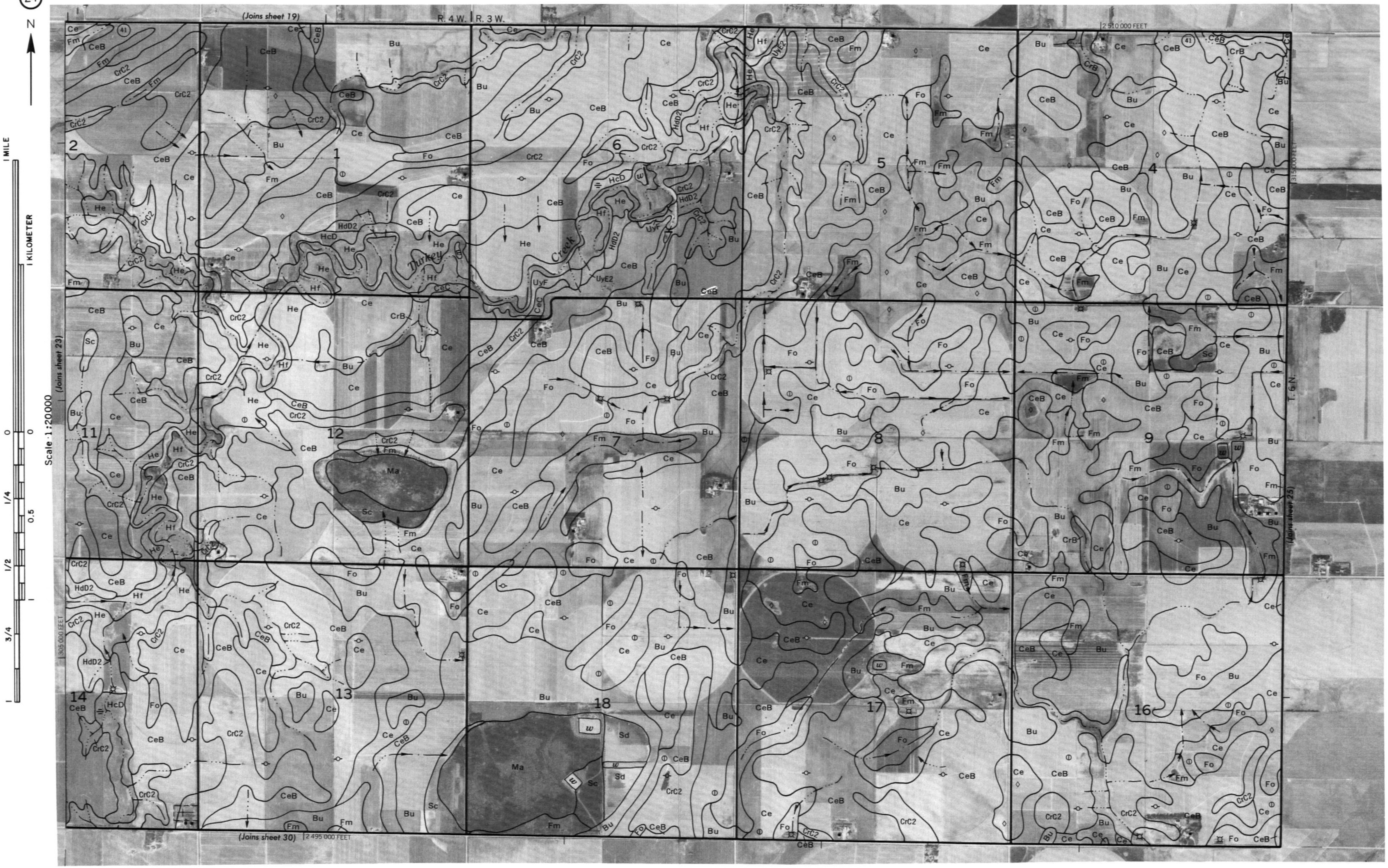


1 MILE
1 KILOMETER
0
1/4
1/2
3/4
0
0.5
1

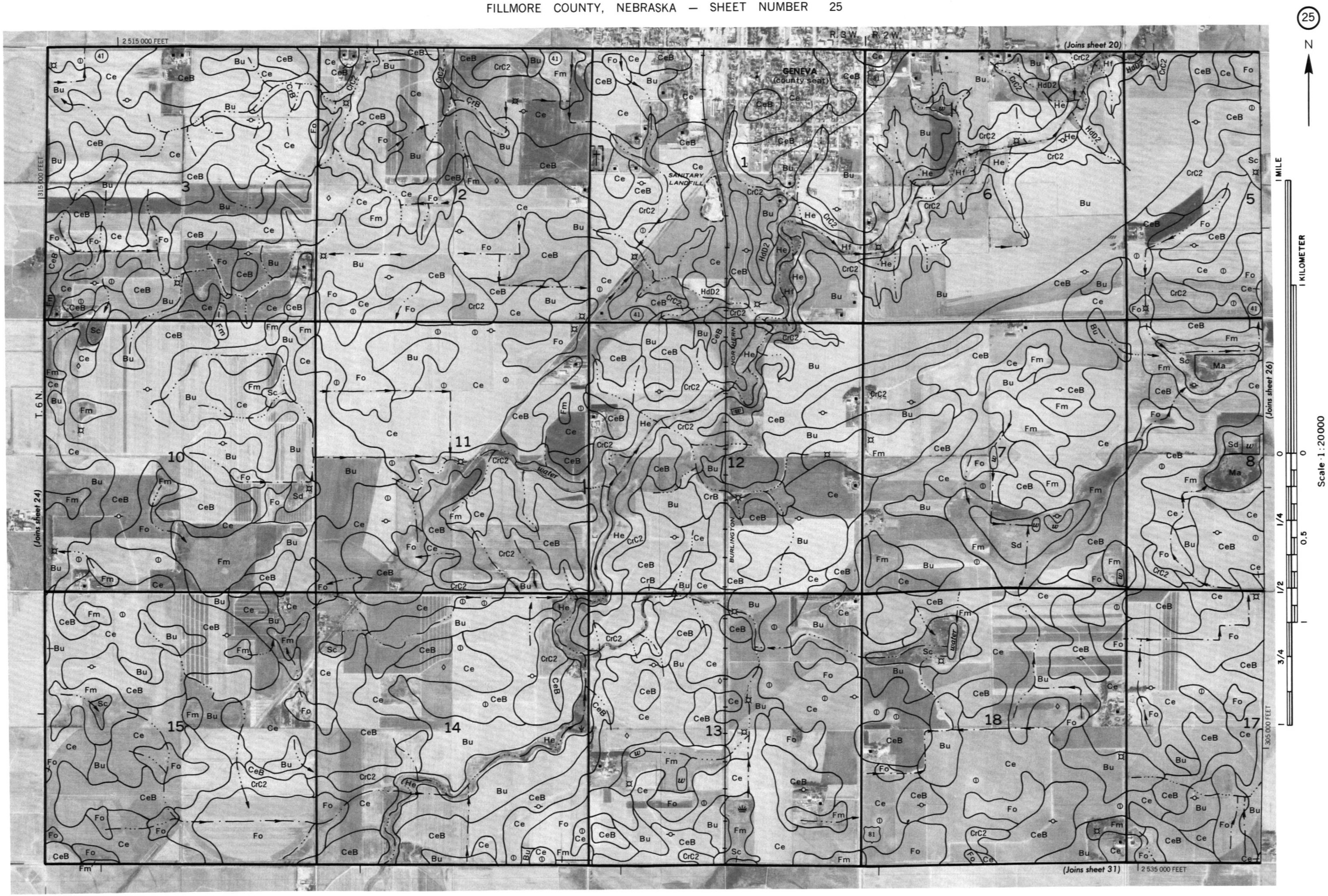
Scale 1:20000

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

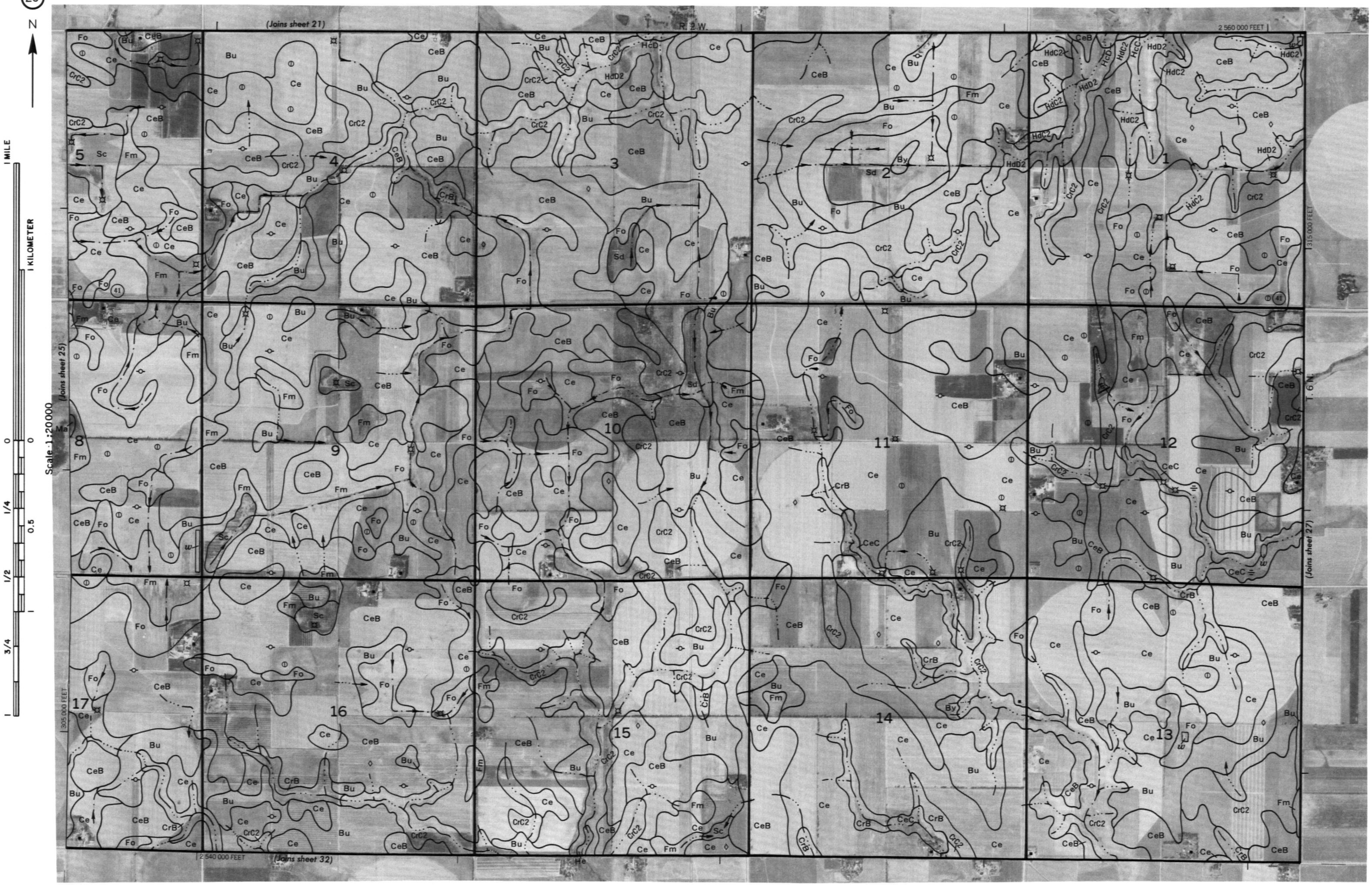
24



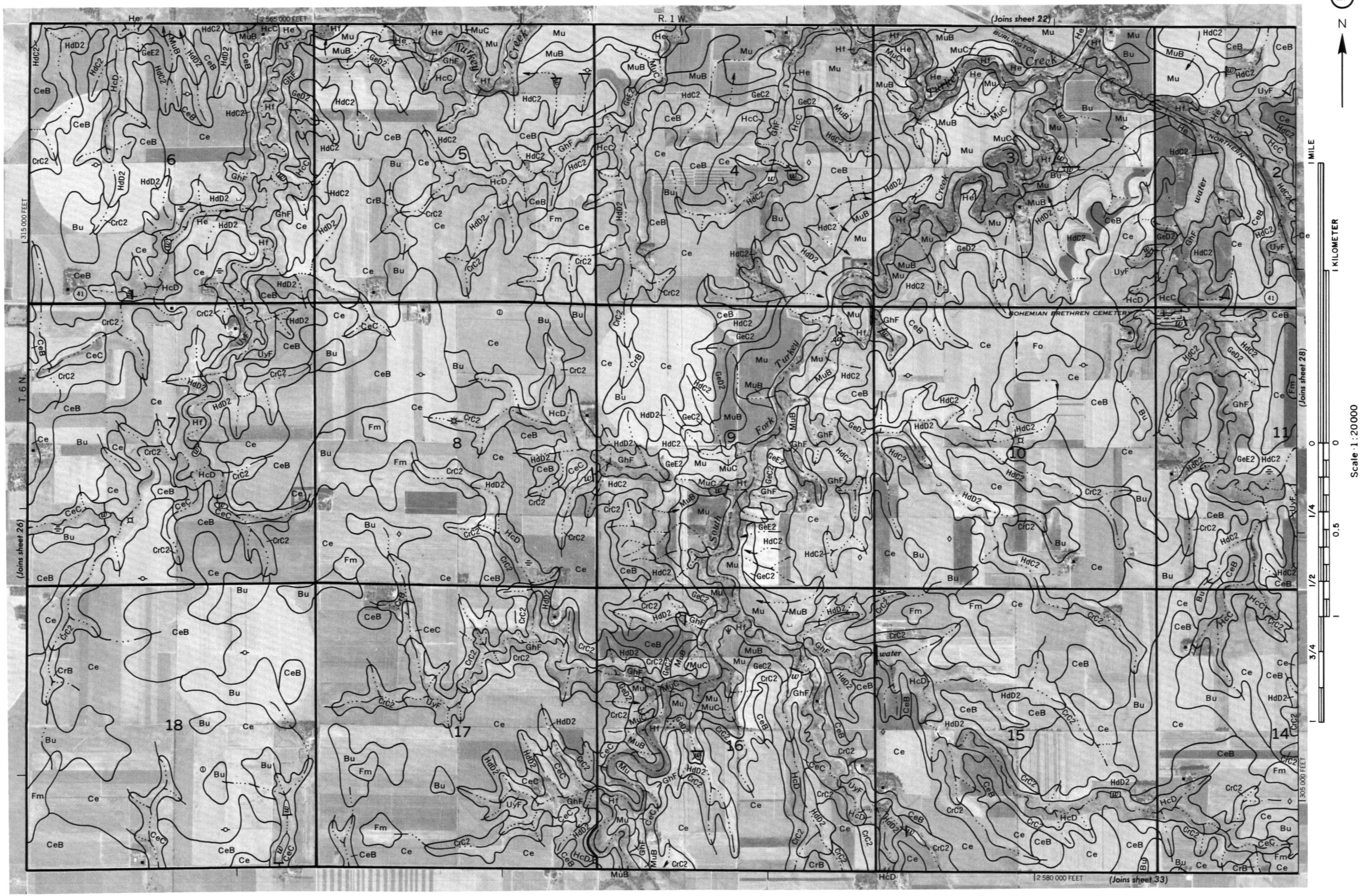
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



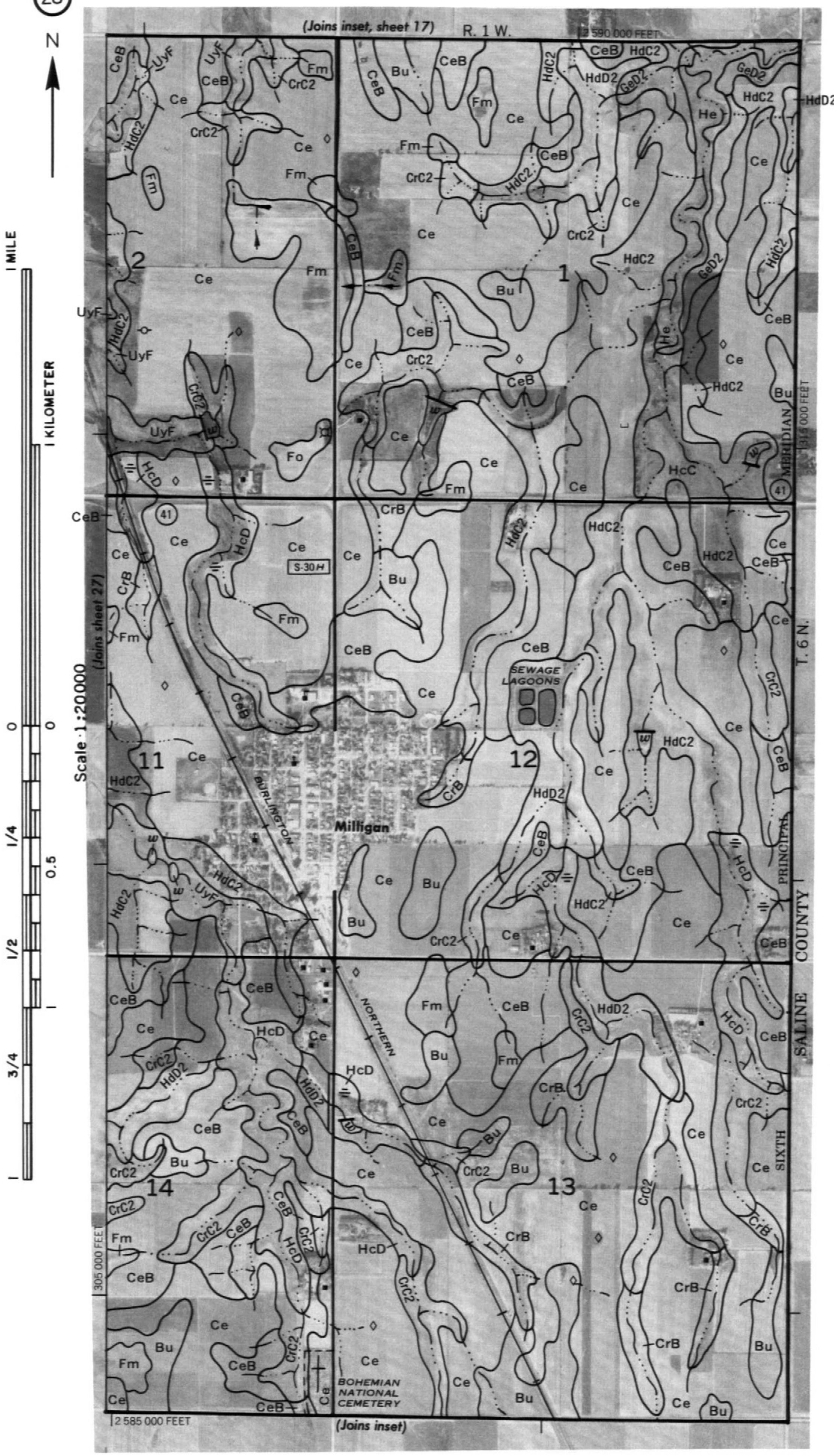
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

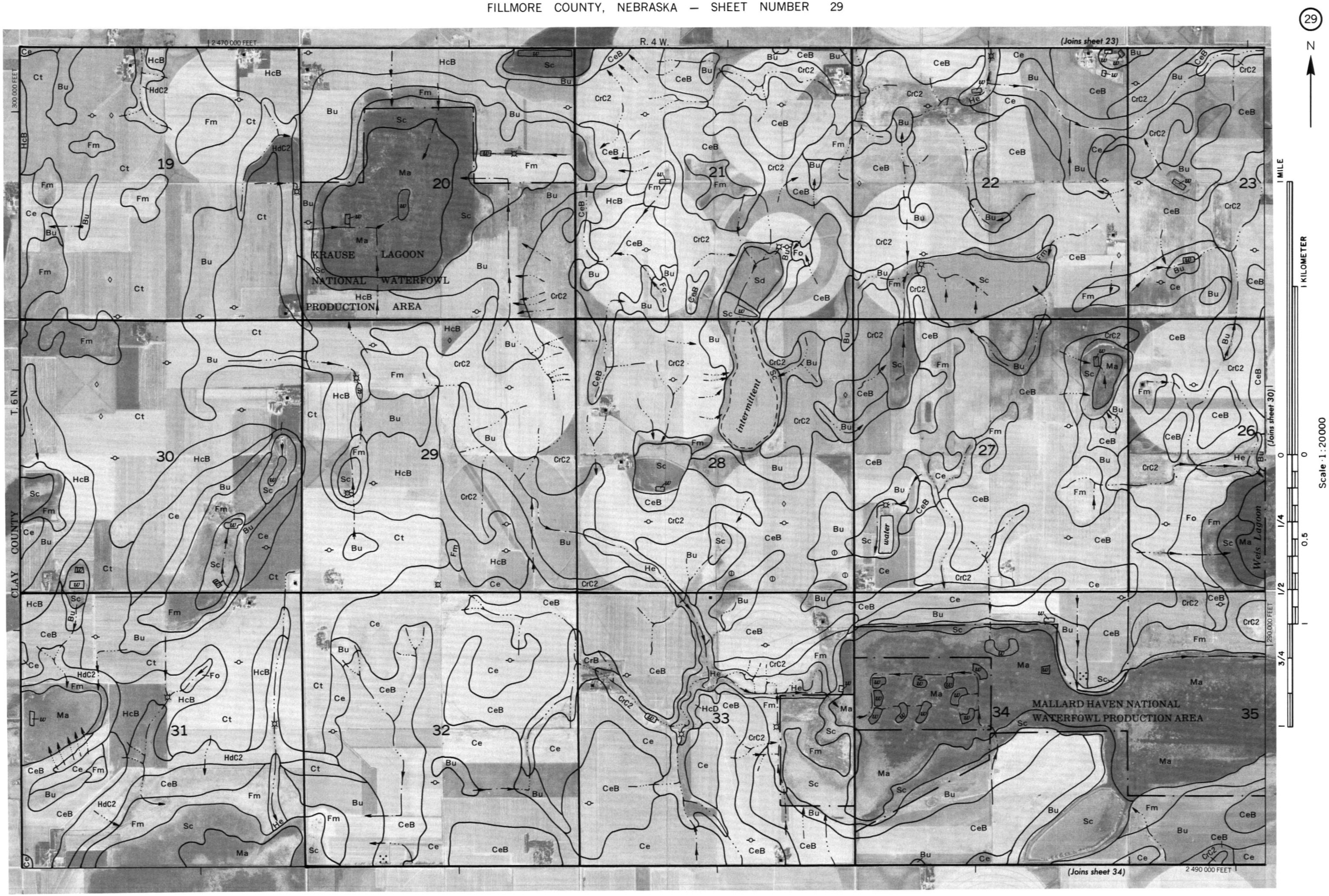


This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

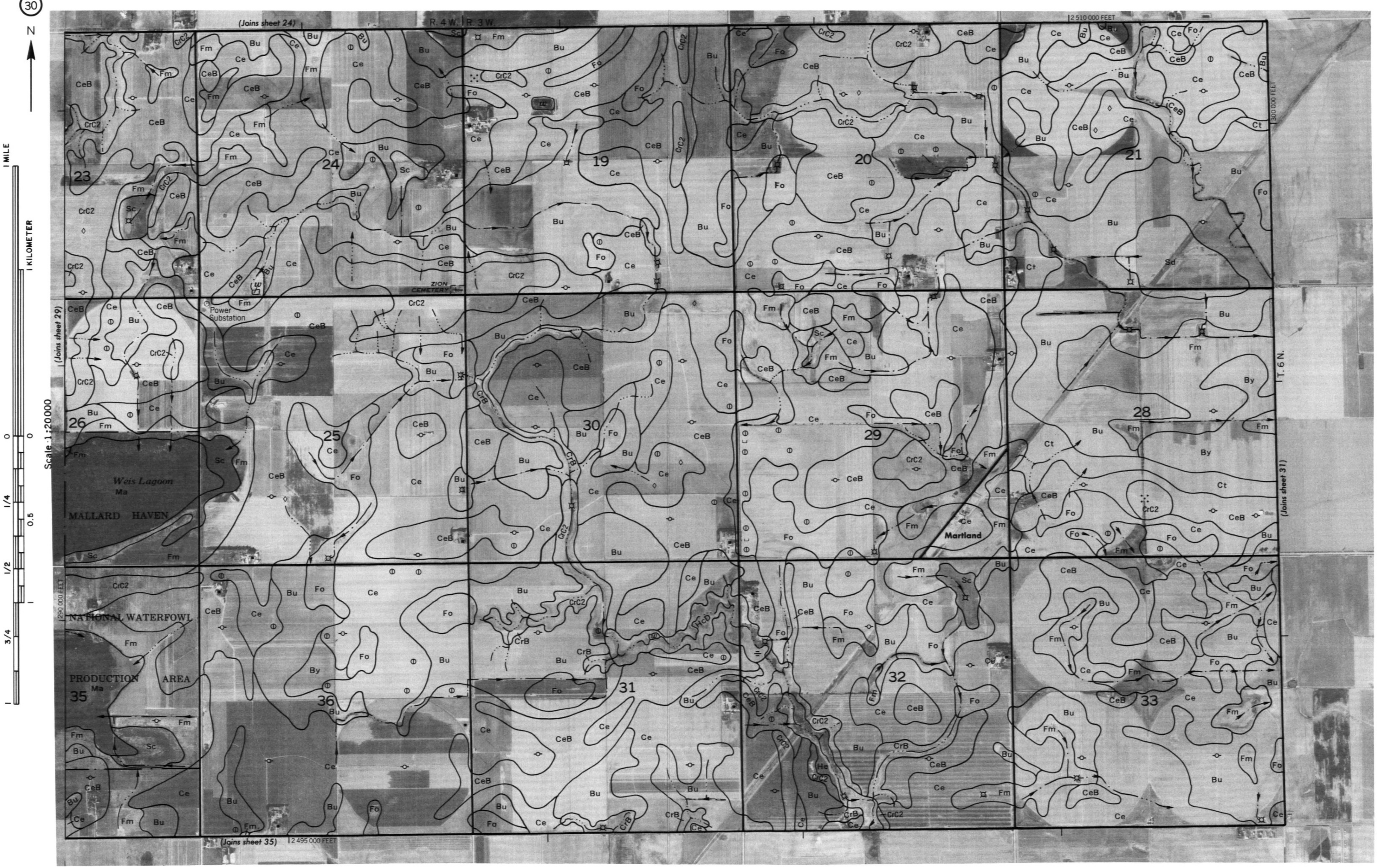


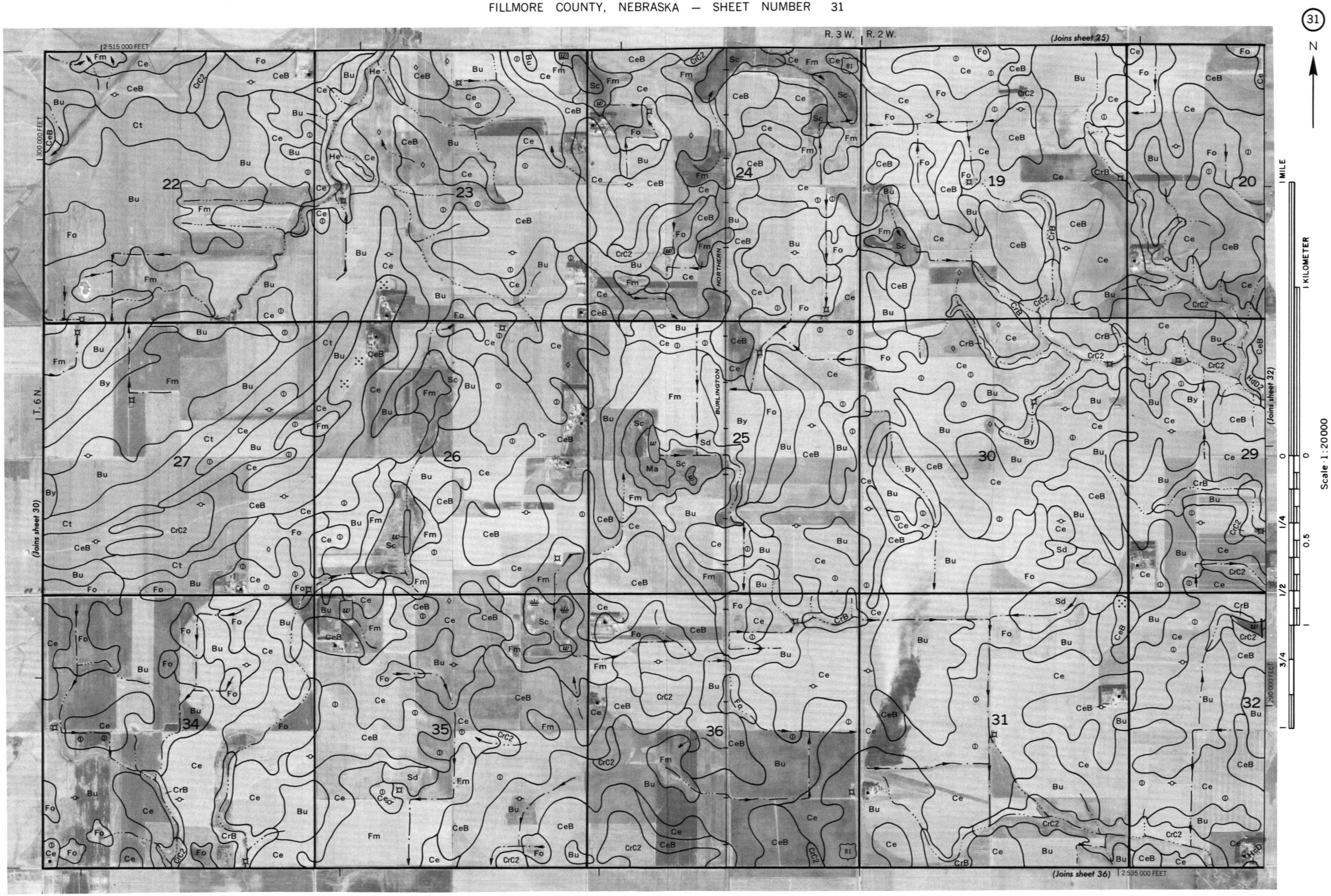
4000 AND 5000-FOOT GRID TICKS

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

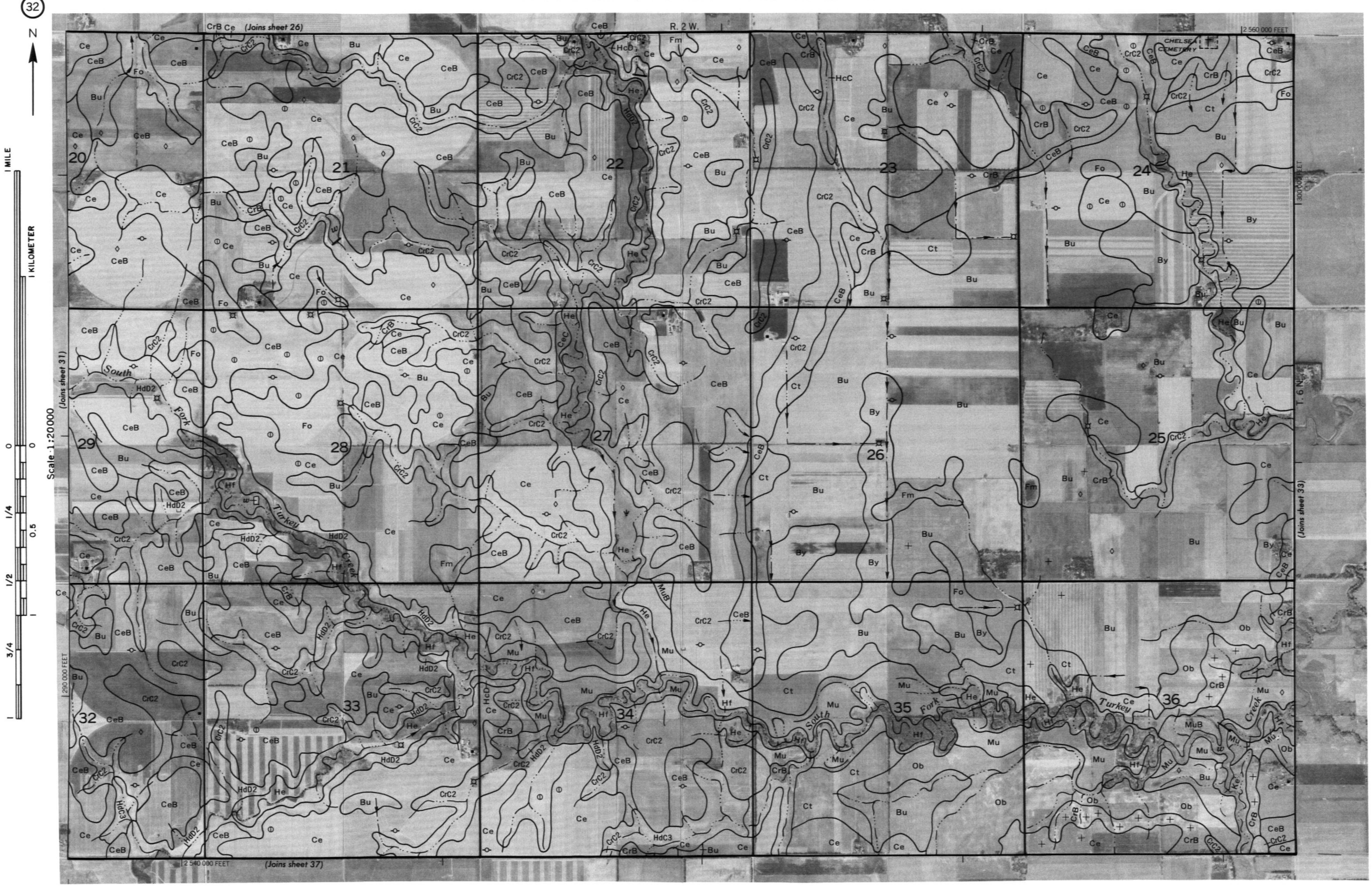


This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

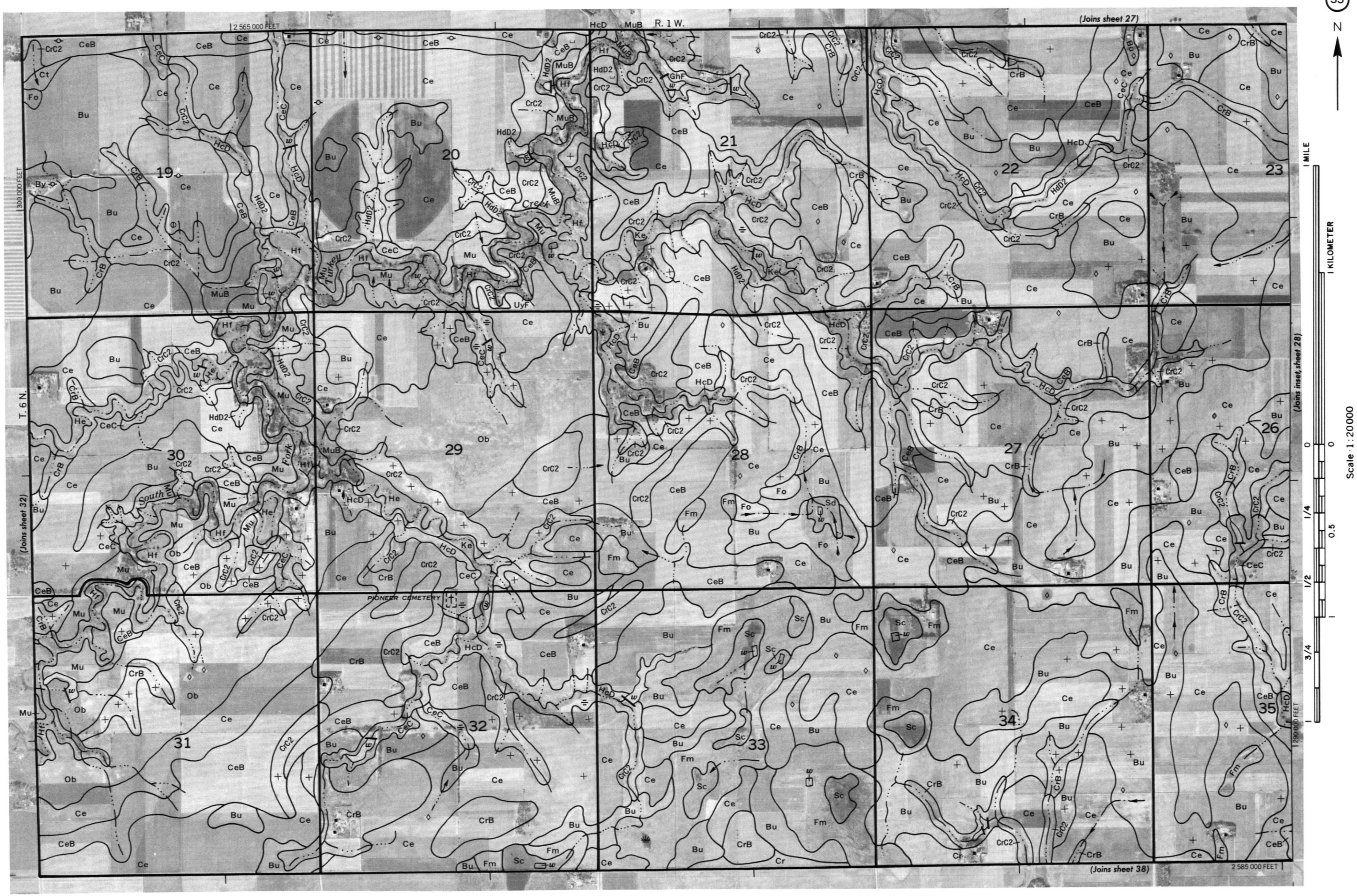

30
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 24)
R. 4 W.
R. 3 W.
2 510 000 FEET
300 000 FEET
T. 6 N.
(Joins sheet 29)
(Joins sheet 31)
(Joins sheet 35)
2 495 000 FEET
290 000 FEET
ZION CEMETERY
Power Substation
Weis Lagoon
MALLARD HAVEN
NATIONAL WATERFOWL
PRODUCTION AREA
Martland
19
20
21
23
24
25
26
28
29
30
31
32
33
35
36



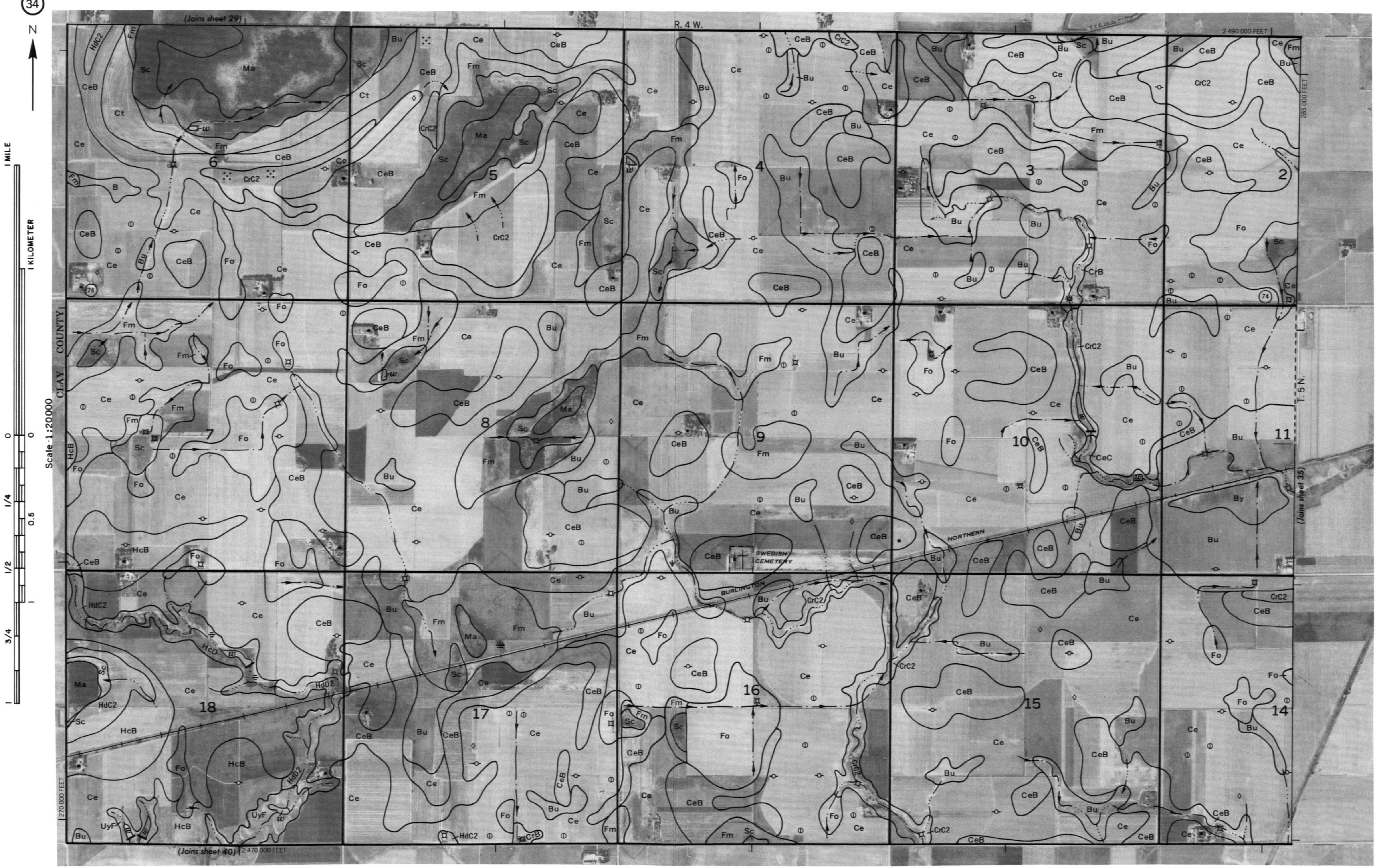
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



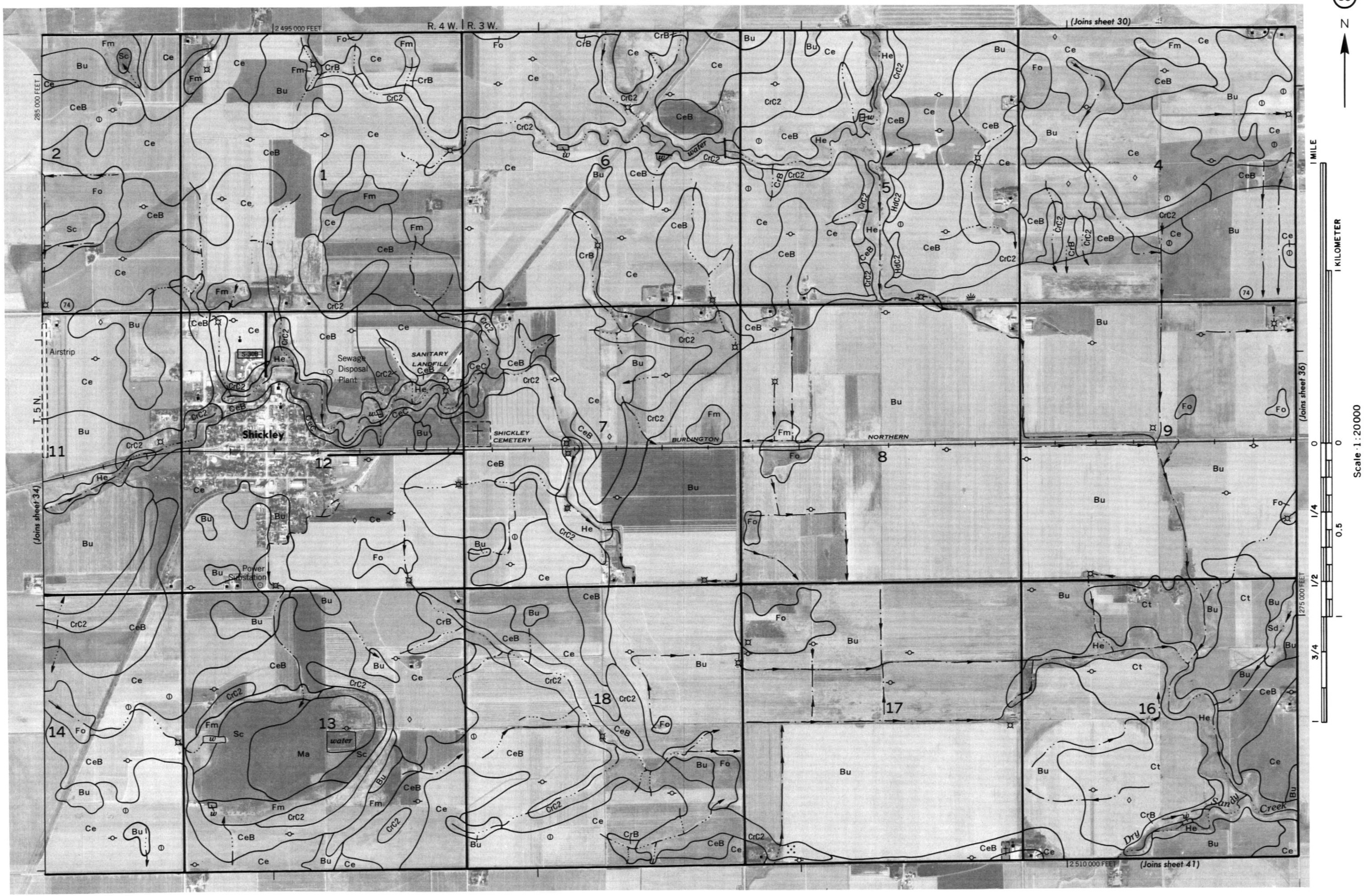
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



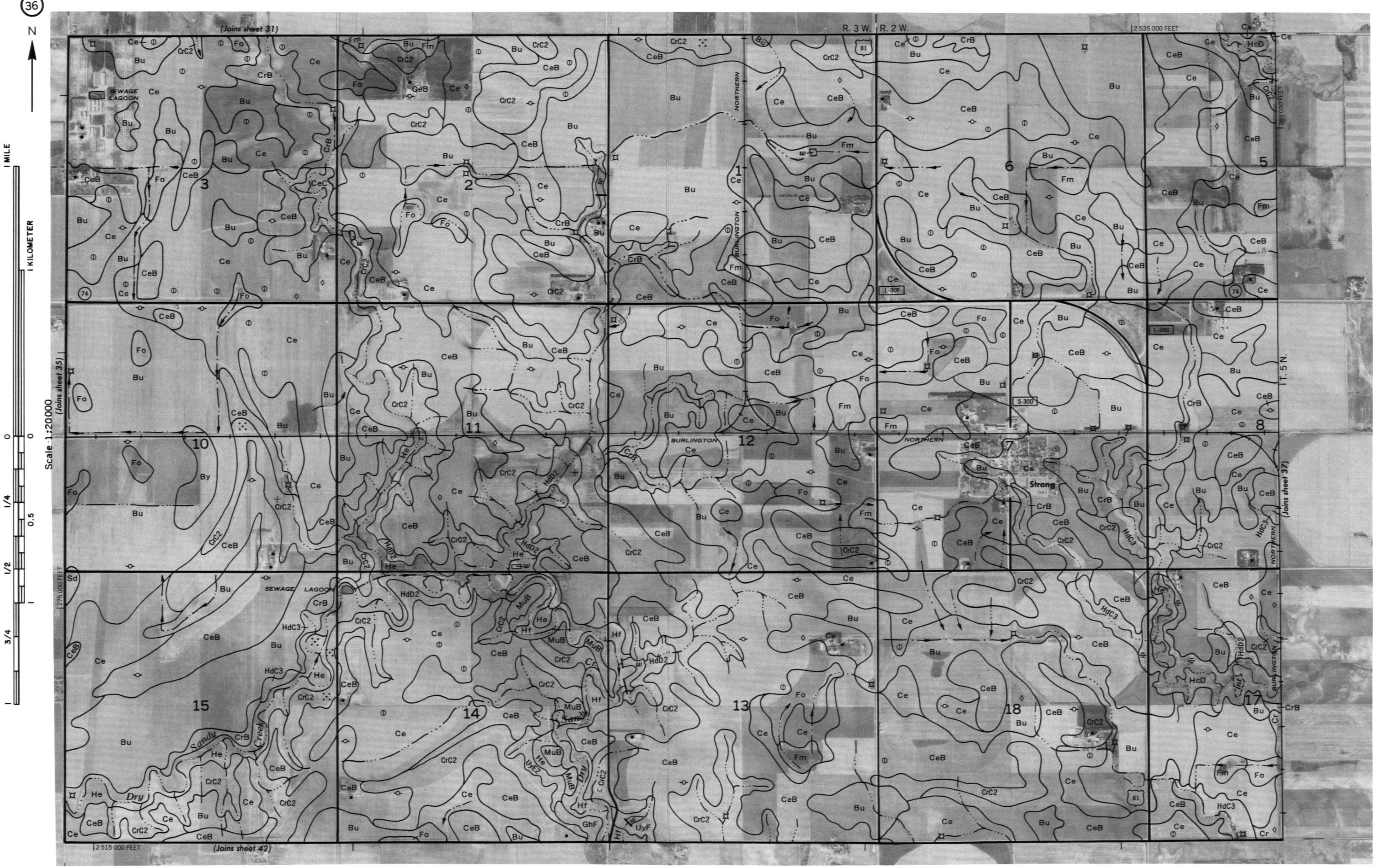
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



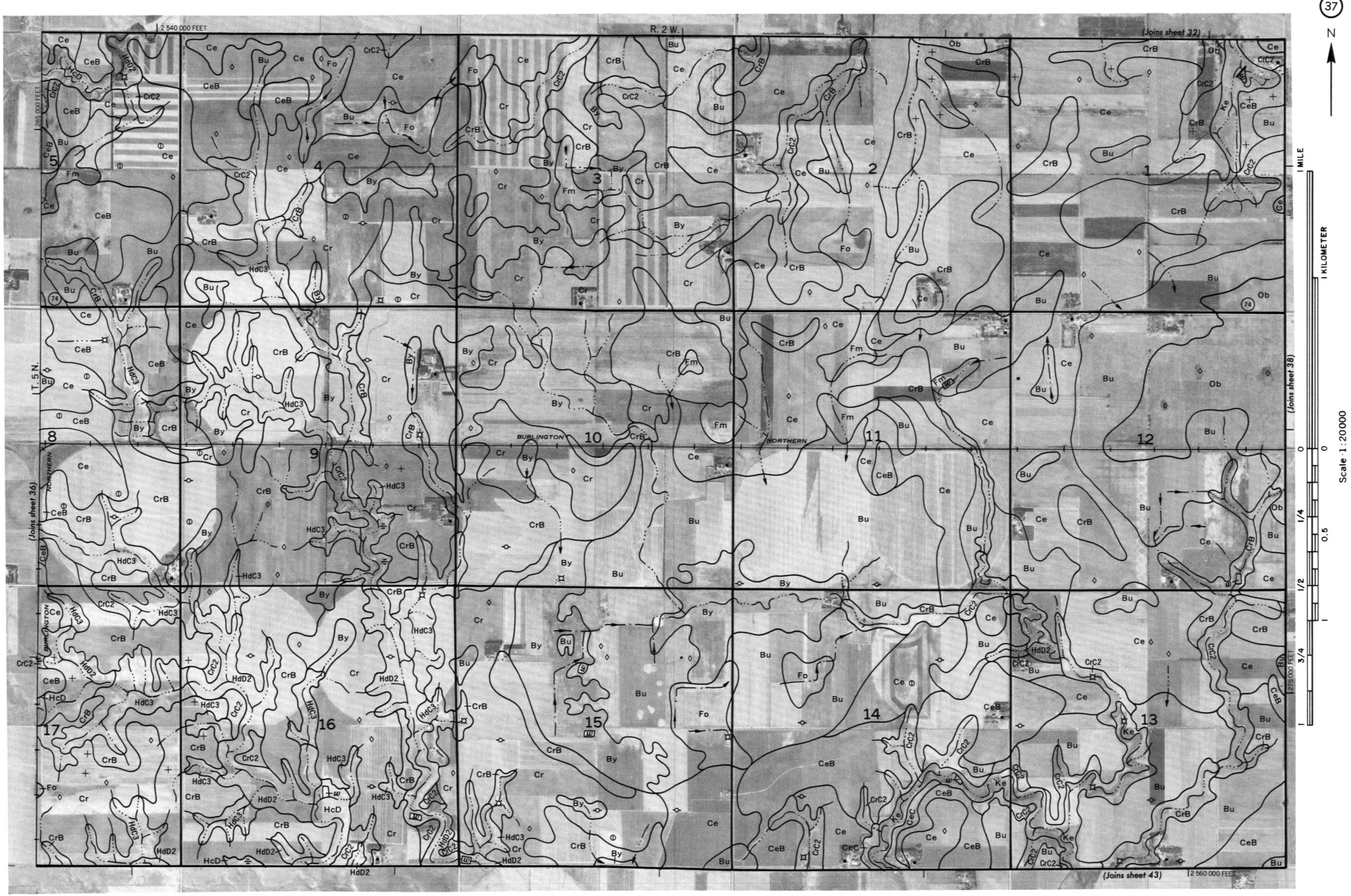
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



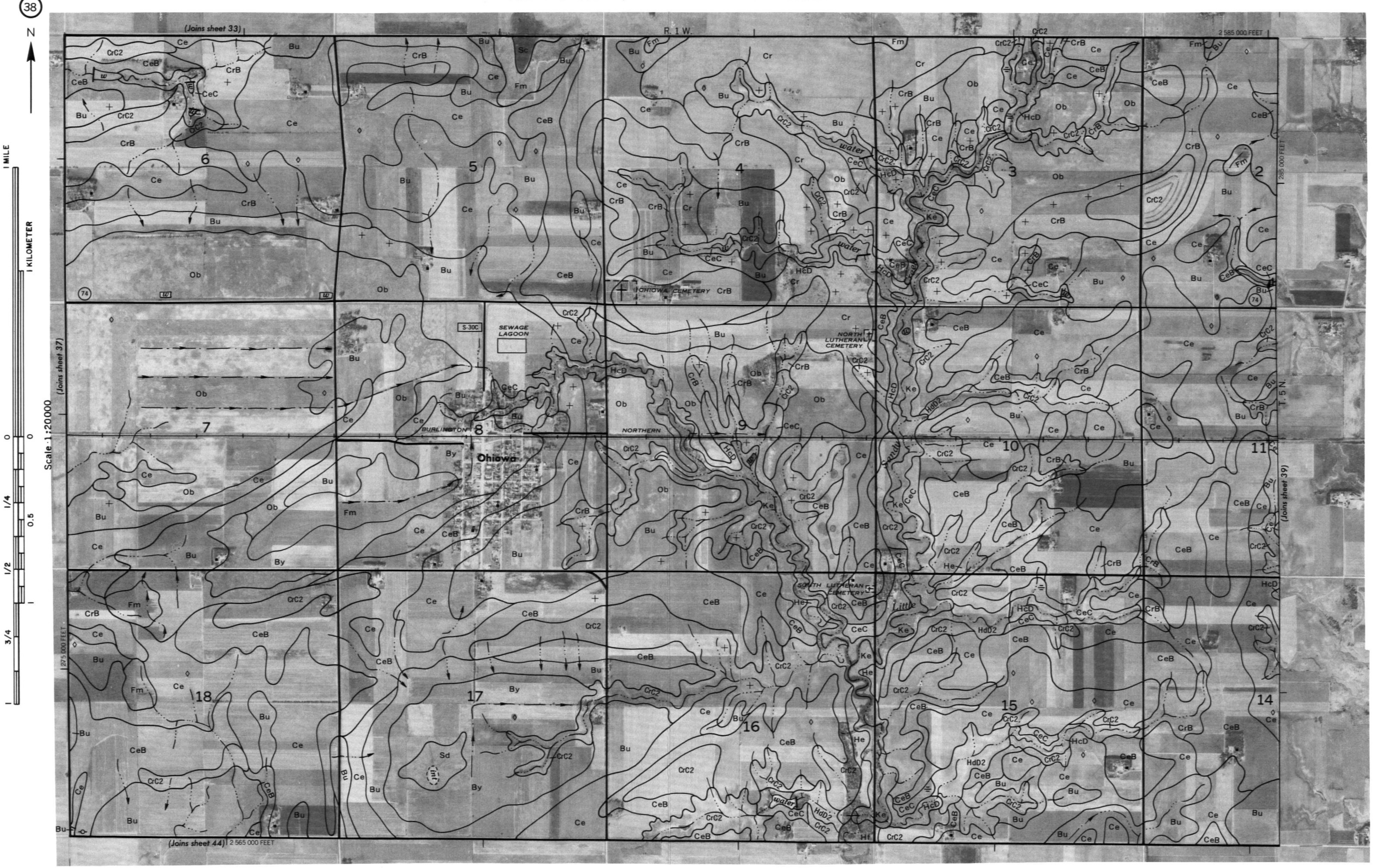
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

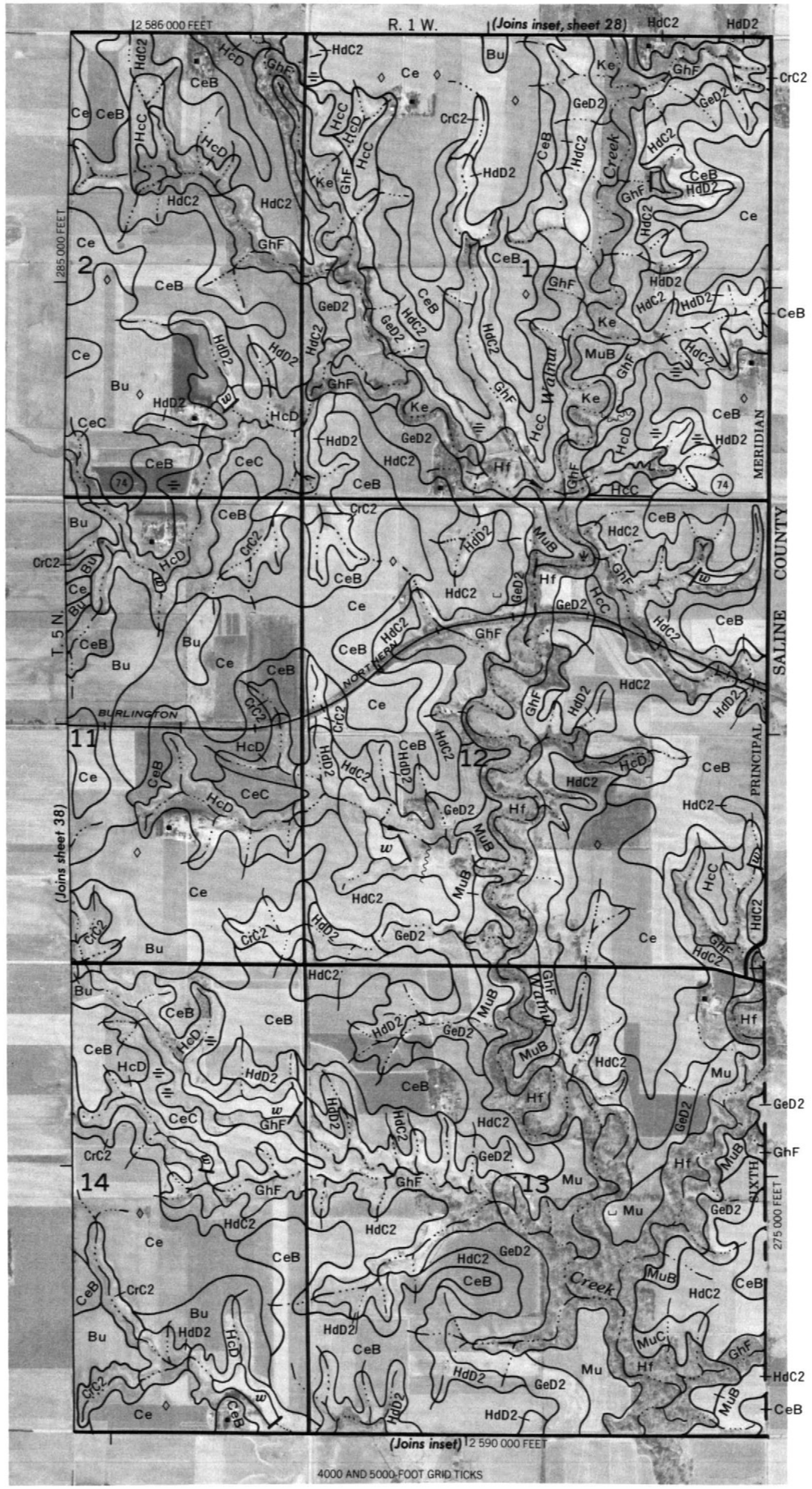


This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

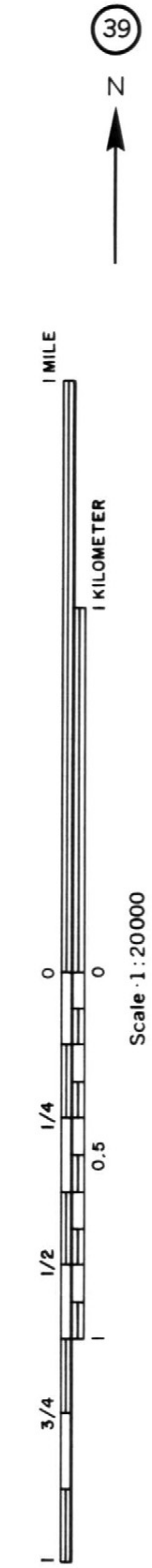


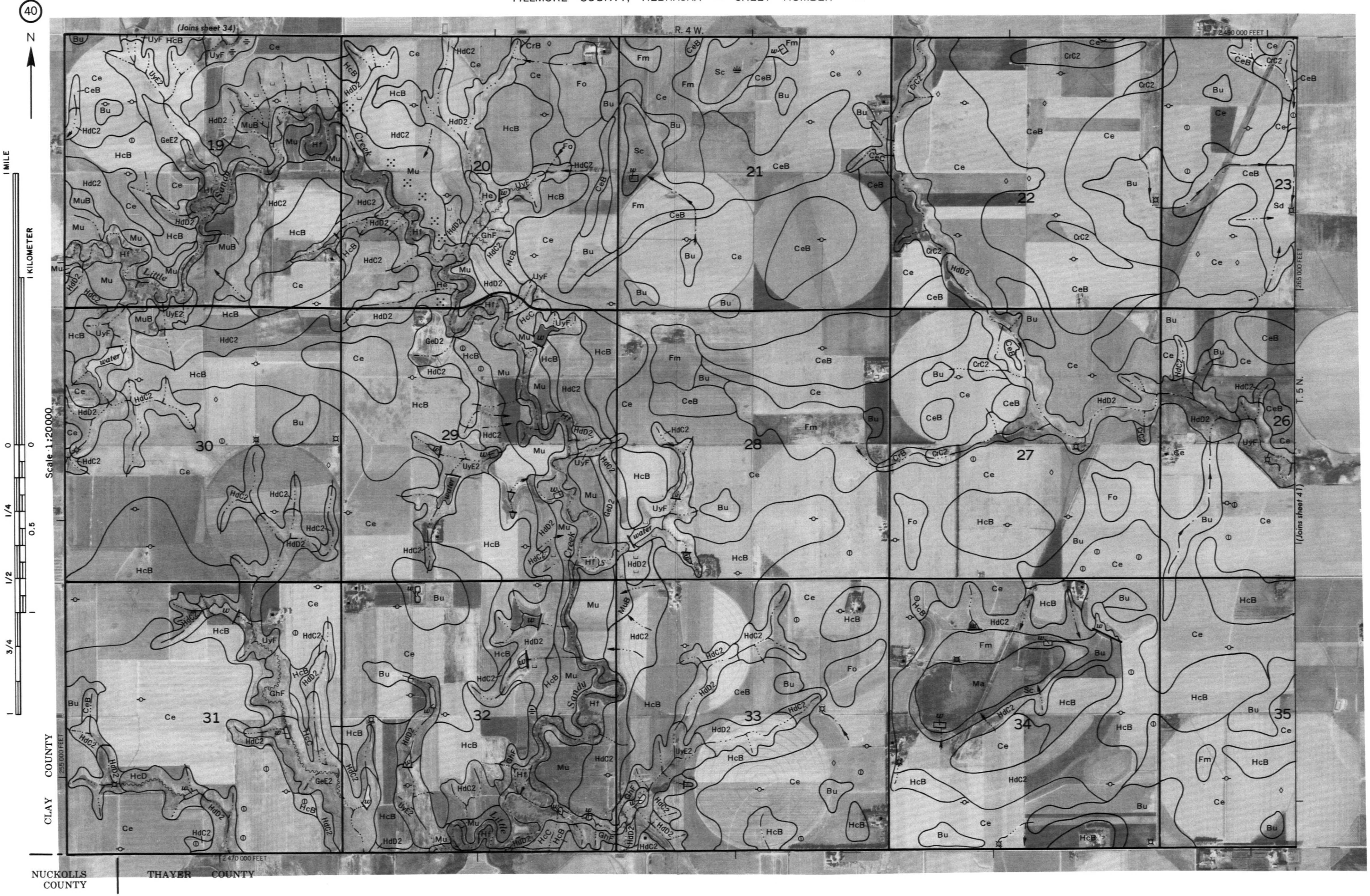
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

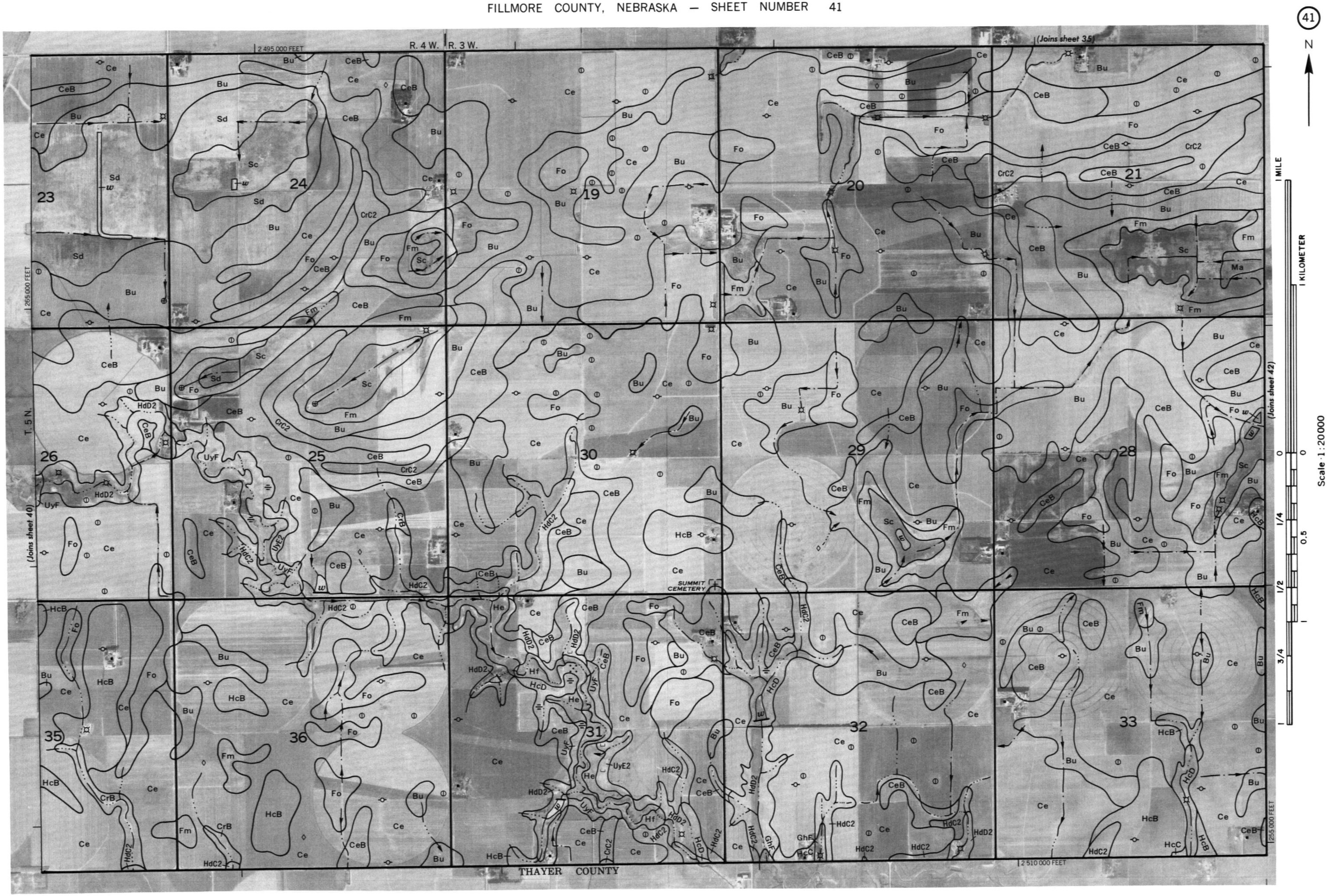


JEFFERSON COUNTY

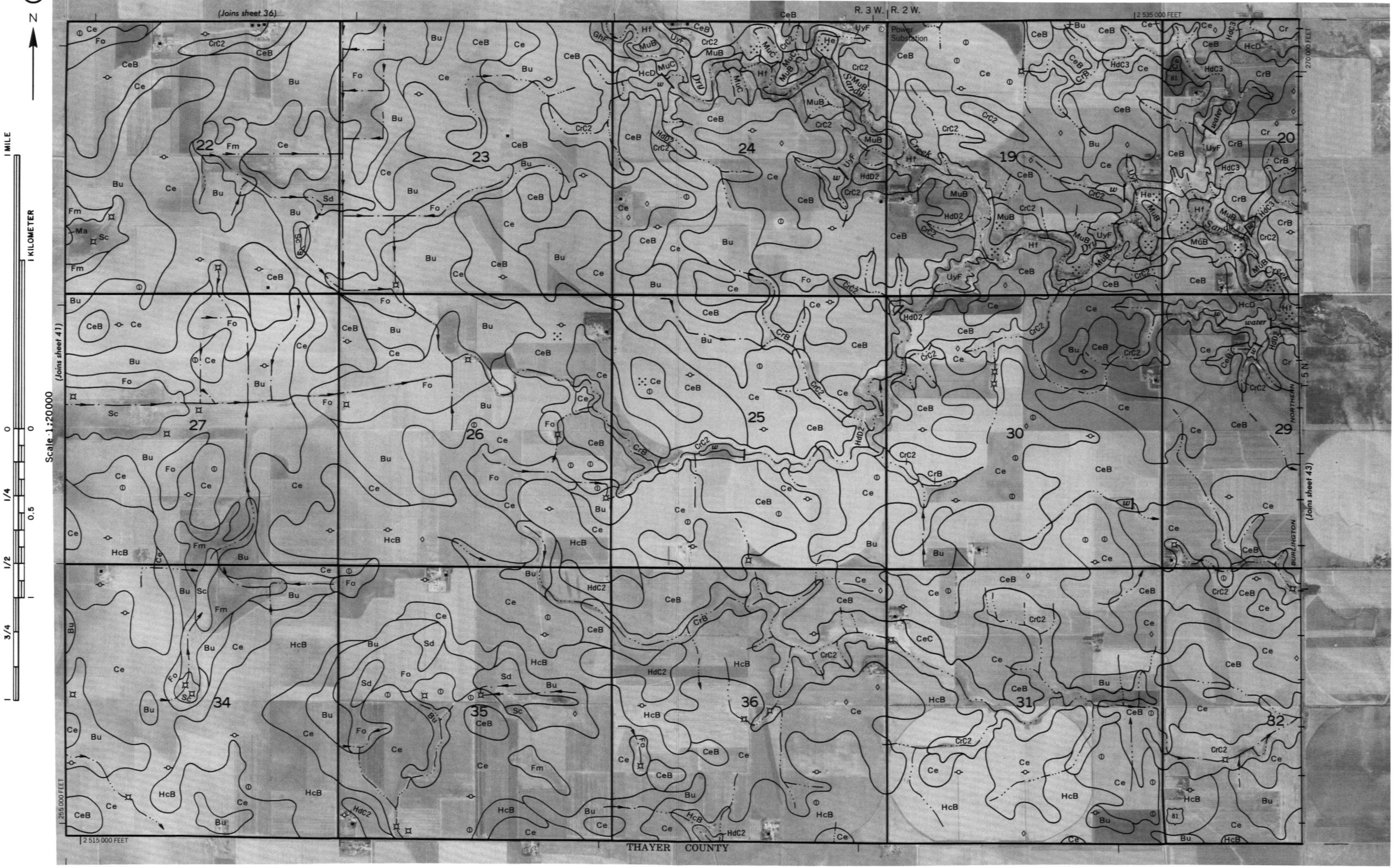




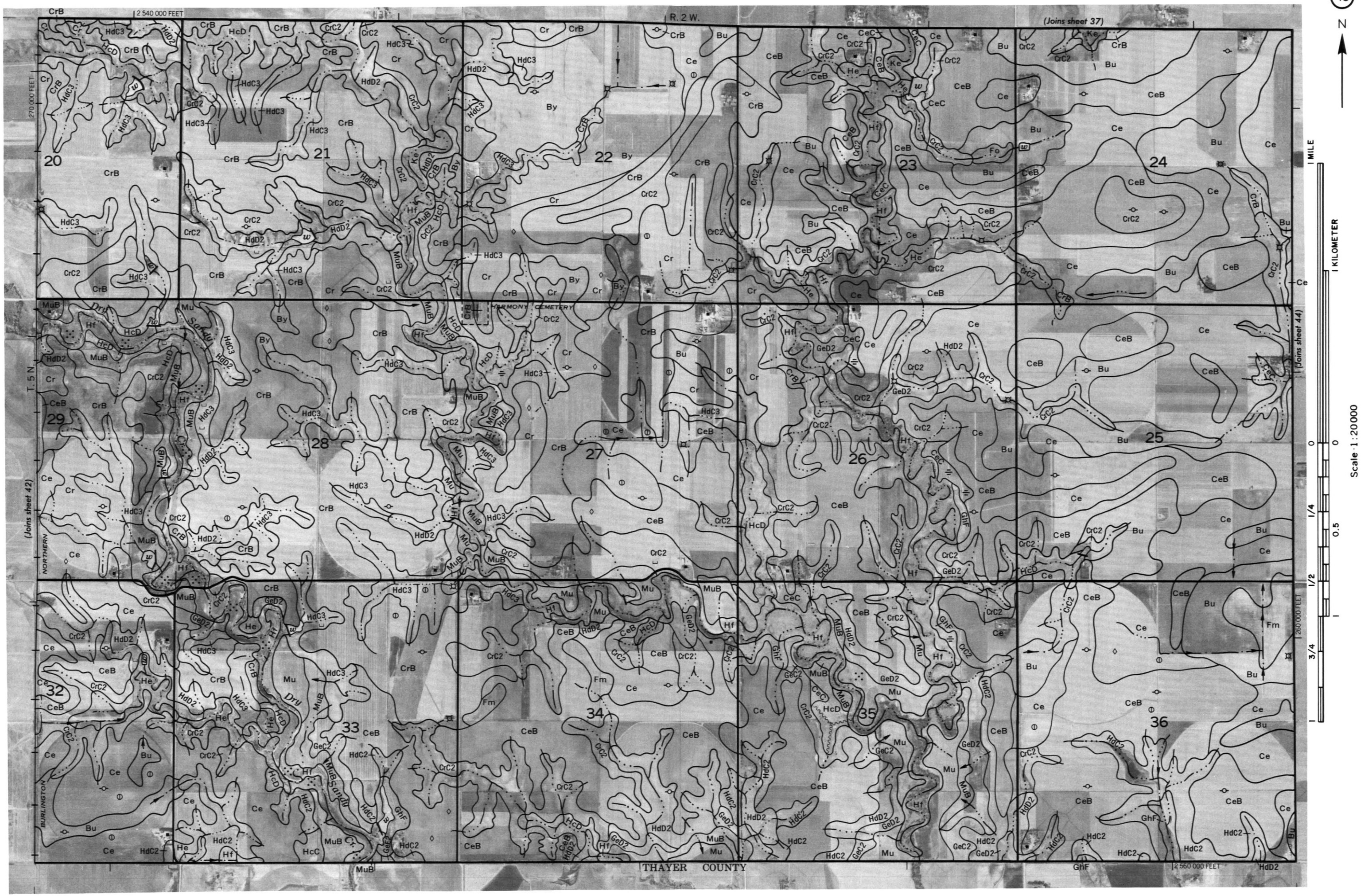
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



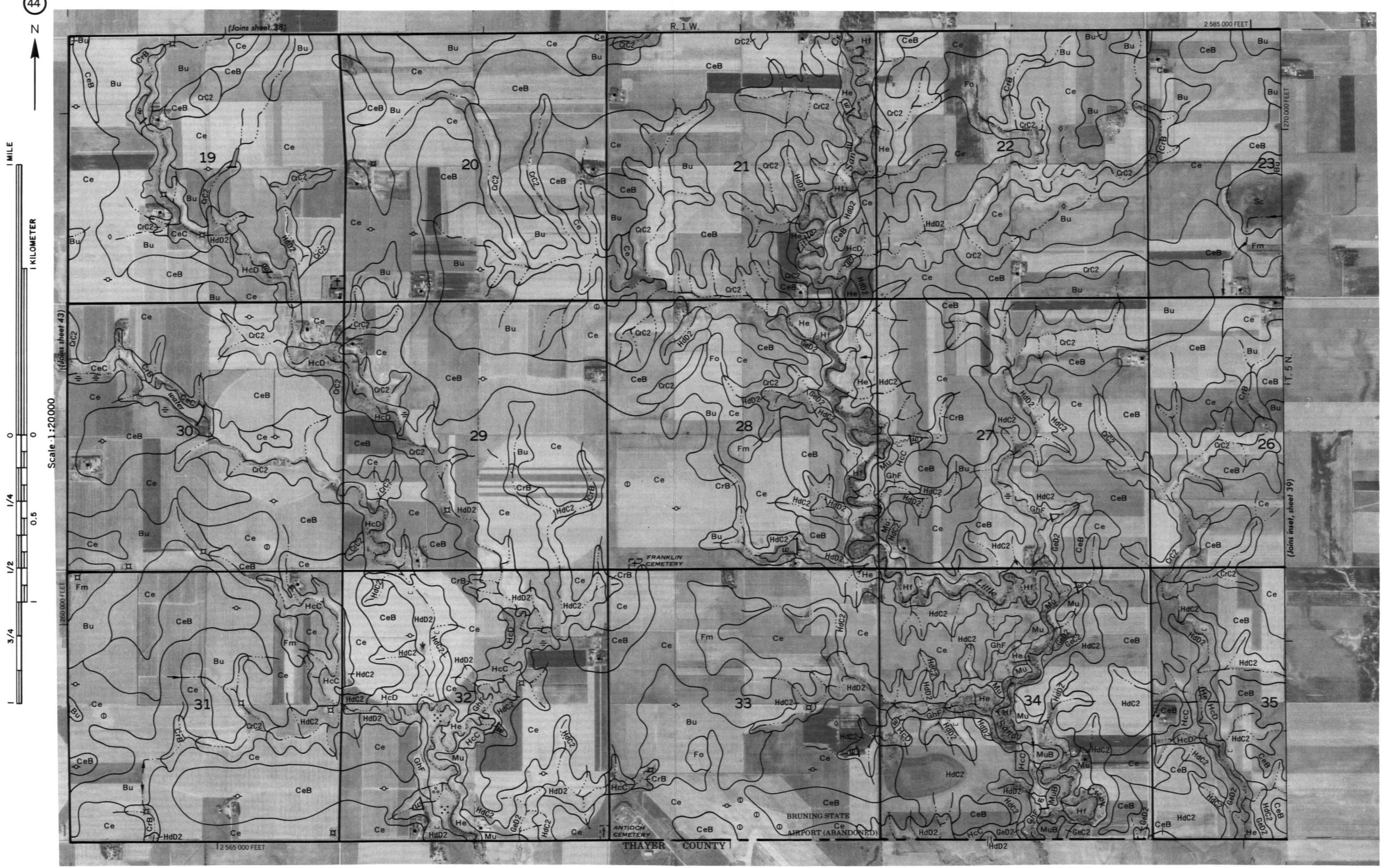
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.